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VOLUME XIV

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Volume XIV

INTERAVIA

December 1959

WORLD REVIEW OF AVIATION AND ASTRONAUTICS

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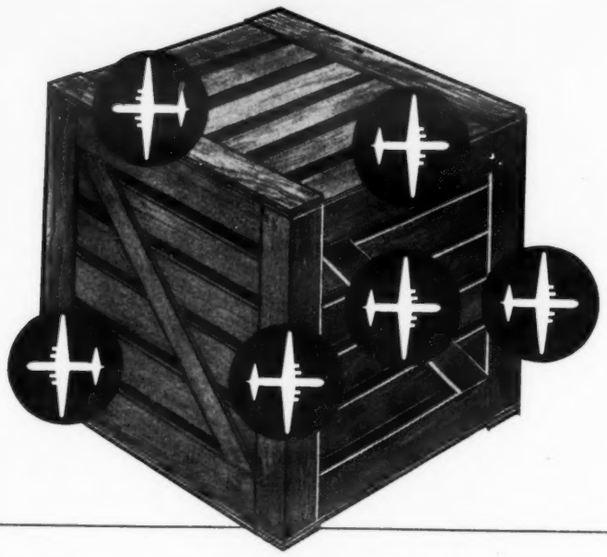
SABENA shares in air freight expansion



During the last 25 years air cargo tariffs have dropped by an average of 50 percent.

In 1923, shortly after Sabena's foundation, the dimensions of packages carried on the company's single-engined de Havilland DH-9s, Spads or Rumplers could not exceed 1 metre in length, 40 centimetres in width and 40 centimetres in height. During the first year Sabena aircraft transported some 16 tons of goods at a price of about 5 Belgian francs (of those days) per kilo.

In 1933 the company's fleet of three-engined Fokker F VIIs, Handley Pages and Westlands transported over 400 tons of freight between Brussels and the twelve European cities covered by its network.

The volume of any package carried in the aircraft hold could not exceed 100 cm × 50 cm × 50 cm, and the price of transporting one kilo of goods varied between BFr. 2.05 and BFr. 13.70, i.e. BFr. 4.85 and BFr. 32.25 of today's money.

Now, after a quarter of a century, the weight of cargo transported in Sabena aircraft is 55 times that carried in 1933, and the cost per kilo of consignments weighing over 45 kg has been reduced by about 50 percent, calculating today's prices in francs of 25 years ago.

In 1933 the most modern aircraft could carry about a ton of cargo. Today's four-engined aircraft can transport nearly 10 tons in their holds, which are equivalent to a shed 8 metres long, 5 metres wide and 3 metres high and can take packages with a volume 25 times that of the "packets" loaded onto the "heavy freighters" of 25 years ago.

Sabena's cargo network covers practically the whole of western Europe, and during 1957 the freight tonnage carried by the company's aircraft reached a total of 22,000 tons, comparable with the load which could be transported by 1,500 railway waggons.

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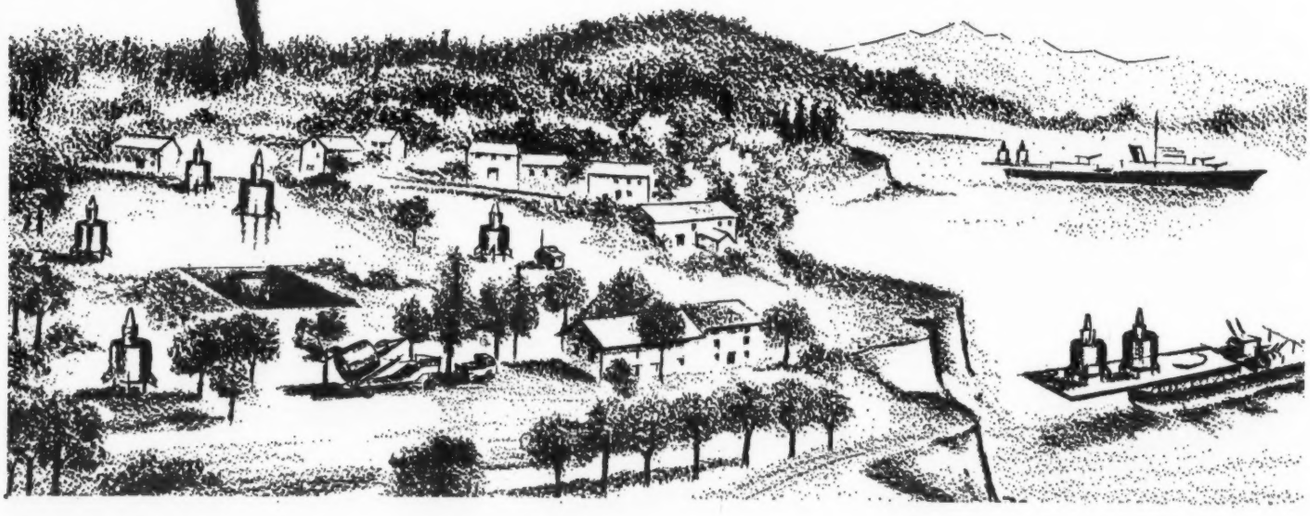

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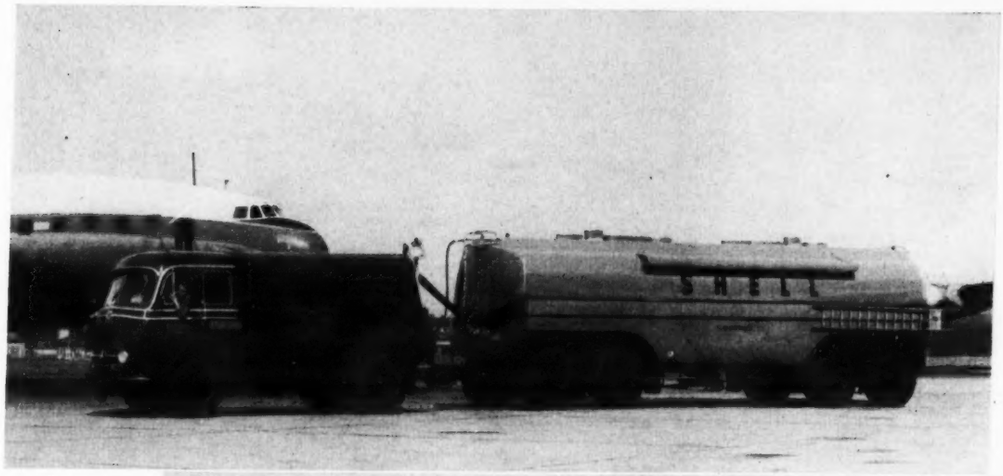

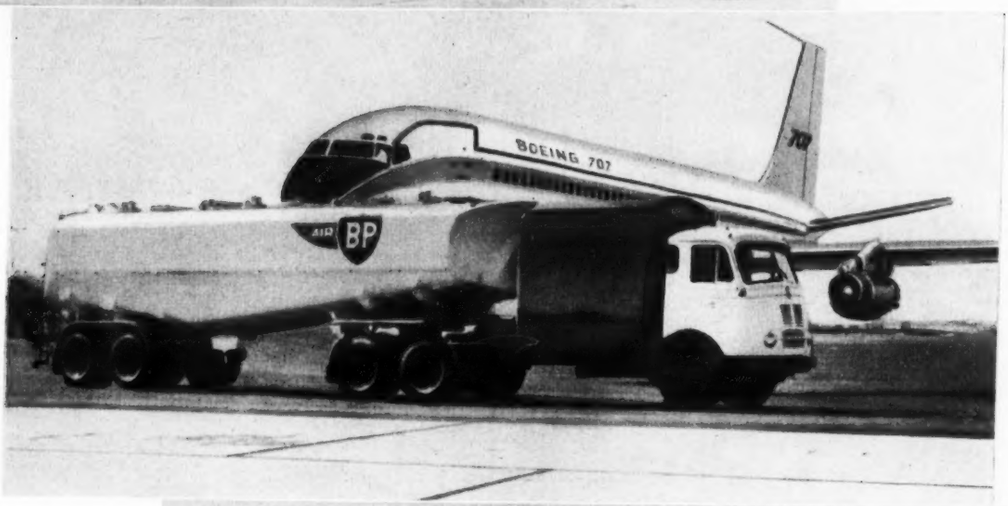

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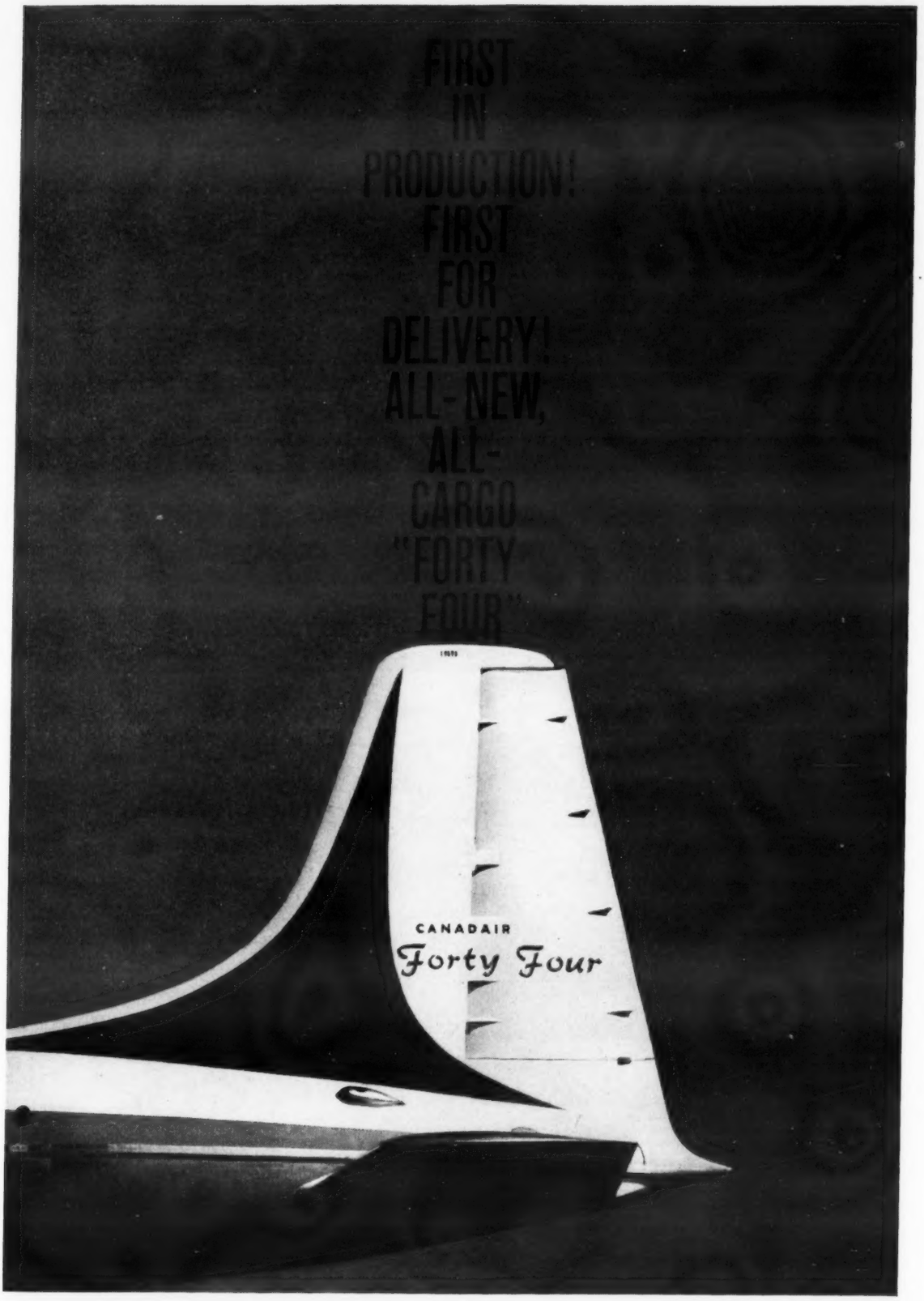
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First photographs of the Canadair Forty Four, taken September 30, 1959 in Montreal. The "Forty Four" is now on the line for Seaboard and Western Airlines Inc., The Flying Tiger Lines and the Royal Canadian Air Force.

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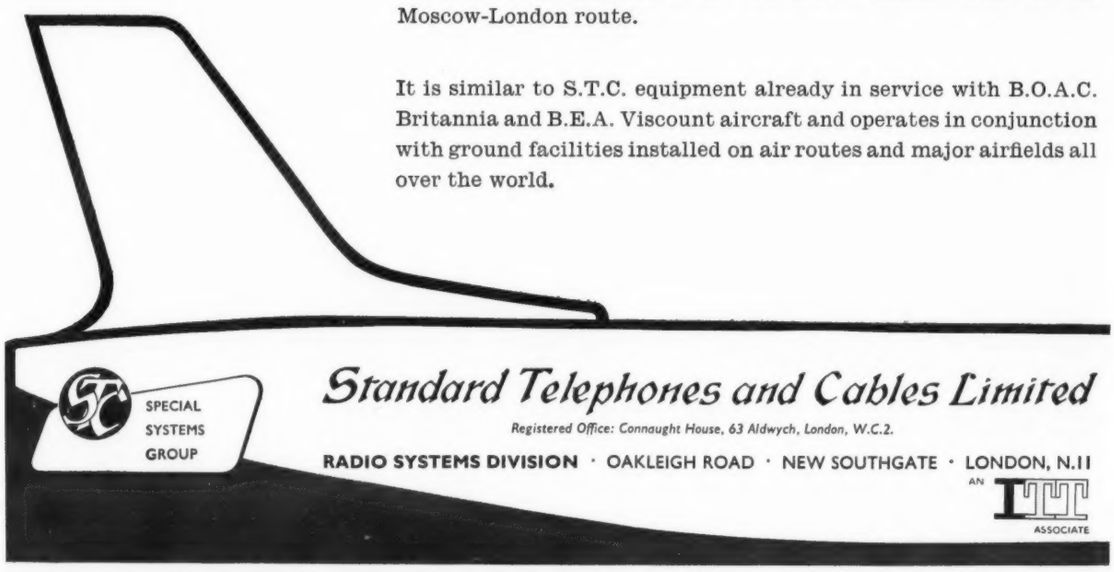

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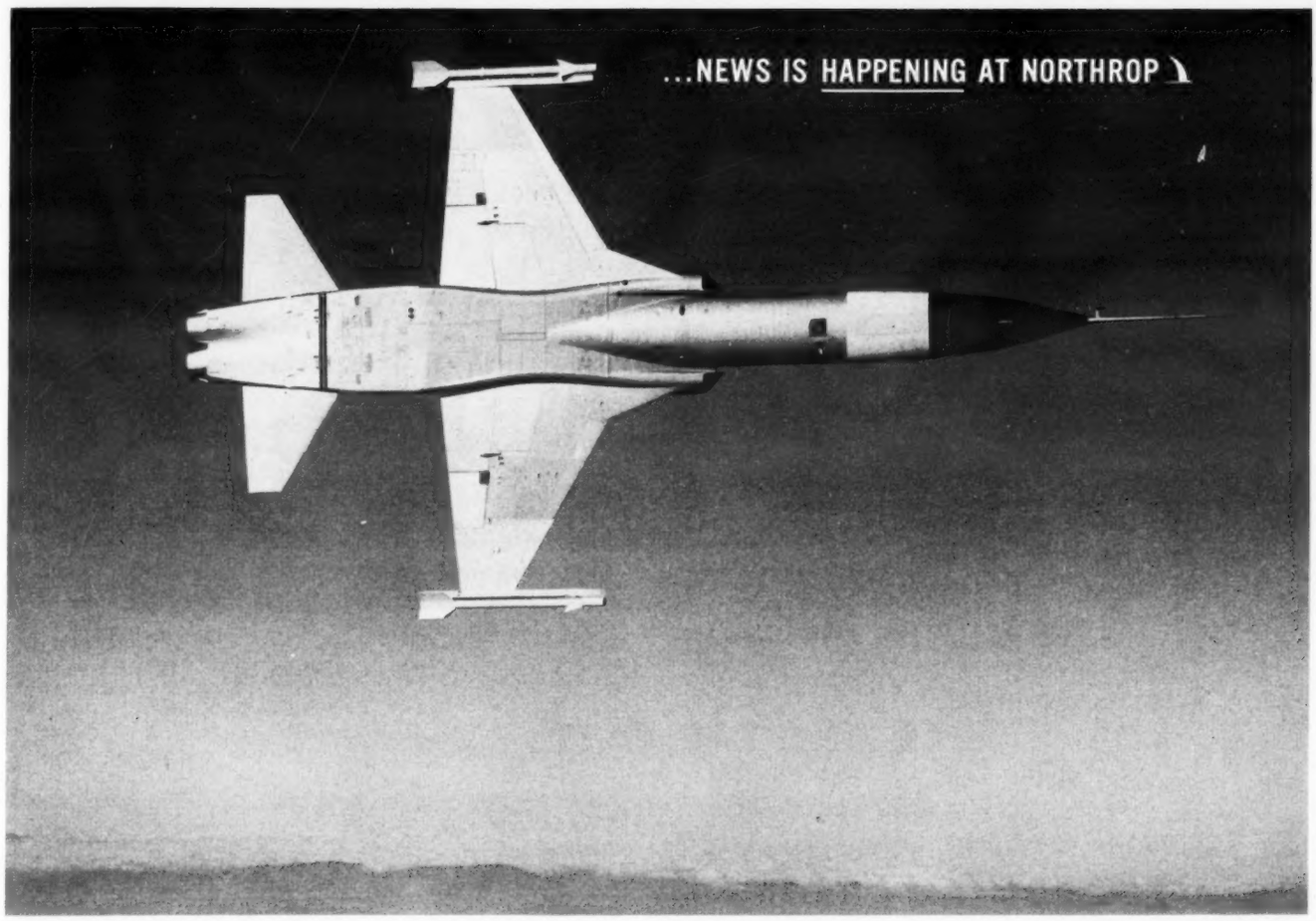

Flight after flight proves the high performance of Northrop's N-156F...the Freedom Fighter

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Northrop's N-156F is the first airplane U.S.-designed specifically for defense needs of other Free World nations. The Freedom Fighter takes advantage of the new General Electric high thrust-to-weight ratio J85 jet engines, new lightweight materials, new design technology that no other fighter yet reflects.

With its multi-purpose mission capability, performance and ease of operation, the N-156F can virtually double a nation's effective fighting force. The N-156F's light, simple design cuts procurement costs, saves fuel, eases maintenance, and reduces the need for costly ground support and rare skills by approximately 50 per cent. The Freedom Fighter is so highly mobile that it can take off any time—almost anywhere—to keep more aircraft battle-ready along a wider and more dispersed perimeter for maximum striking power—at minimum vulnerability.

No weapon system today matches the Freedom Fighter's advantages. It costs less to buy, to fly, and to maintain. And because the N-156F is designed for production outside the United States, it will contribute to the economies of the countries it will defend.

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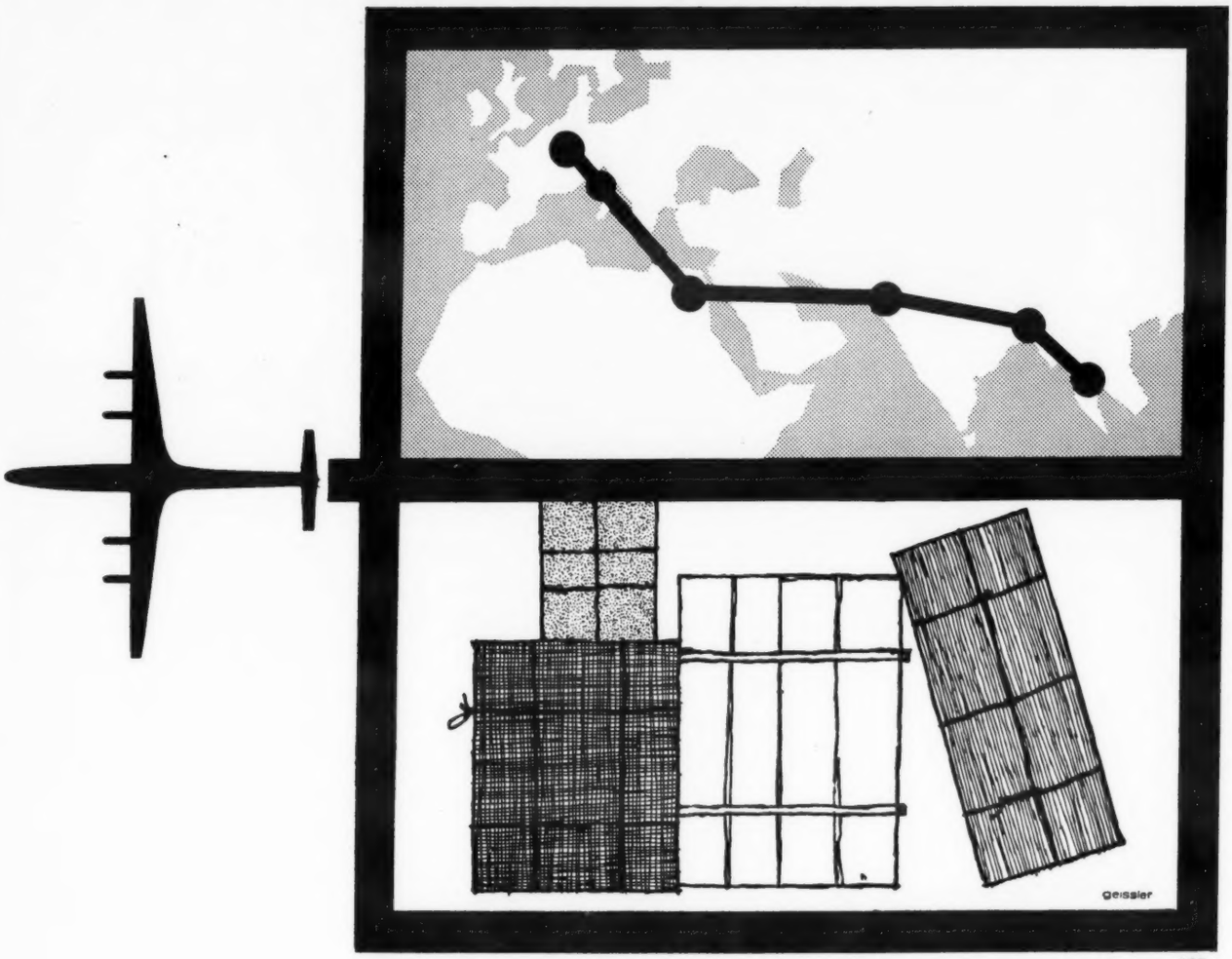

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Thompson Aircraft Tire Corporation treats on the following important subject...

How Many Times Can Jetliner Tires Be Retreaded?

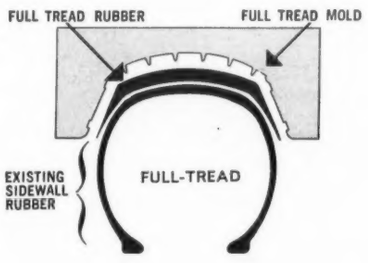
This pertinent question arises constantly in the airline industry and understandably so. Each successive retreading of the same casing represents substantial savings over the purchase of a new tire. Through the years and on ever-increasing fleets of jetliners, retreading savings can run into hundreds of thousands or millions of dollars. We, at Thompson Aircraft Tire Corporation, are being asked repeatedly our professional opinion on multiple retreading and shall attempt to provide it here as briefly as possible.

In principle, there is no theoretical limitation to the number of times a tire can be safely retreaded provided the casing remains in serviceable condition. The casing is always the determining factor. However, there are important things that can be done in the retreading and repairing processes that actually lengthen the service life of a casing! The techniques required are not simple, but through substantial, continuing investment in research and special machinery, Thompson has developed the technological means and retreading capability to lengthen substantially the casing life of jet tires.

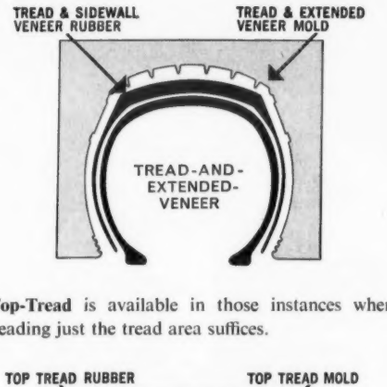
There are several conditions which can make a worn casing unsuitable for retreading and further flying service unless overcome by proper repair. These conditions are: (1) exterior sidewall rubber cracking, (2) casing cuts, holes and other injuries, (3) exposed cords in casing due to skids and excessive wear, (4) tubeless inner liner cracks, blisters, separations and other damage.

A common cause of casing deterioration is sidewall rubber cracking and checking. This is the profusion of small cracks that appear in the sidewalls from age, moisture, oxidation, flex, heat and ozone that expose the inner cord body to eventual deterioration. This can be corrected by replacing sidewall rubber with either **Full-Tread or Tread-and-Extended-Veneer.**

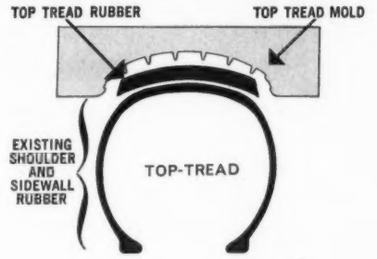
Full-Tread consists of replacing the rubber on the tread area, over the shoulder and down the sidewall approximately midway to the bead.



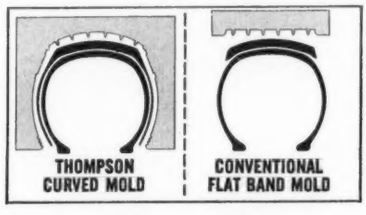
Tread-and-Extended-Veneer consists of replacing the tread area and up to all of the sidewall rubber from bead to bead. Since more rubber is involved in full-tread and tread-and-extended-veneer than for top-tread only, a slightly higher price has been established over trop-tread prices. These slightly higher prices are very small considering that the application of either of these type treads extends the life of tires that would require rejection in any shop that could only top-cap.



Top-Tread is available in those instances when retreading just the tread area suffices.



Thompson is expert in all three types of retreading... **Full-Tread, Tread-and-Extended-Veneer** or **Top-Tread** . . . and can apply the proper type, in each particular instance, that best preserves your casings for longer, more economical service. It is recommended that the decision as to **Full-Tread, Tread-and-Extended-Veneer** or **Top-Tread** be based on expert examination of each casing and that the responsibility for decision be delegated to Thompson. The specialized molds Thompson maintains for the three types of retreading have a fundamentally important characteristic in common . . . mold shapes conform to the distinctive, curved profile of airplane tires and permit relaxed positioning and curing of the casing. This compares with the inevitable spreading and distortion of the casing that occurs when airplane tires are forced into the reduced diameter of flat-profile type retread equipment designed essentially for vehicular tires and used occasionally in bargain retreading.



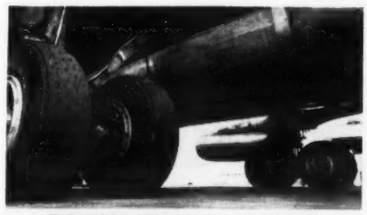
Curved-mold Thompson retreads are not subject to radial and circumferential stresses that induce tread separation when a tire is improperly compressed or stretched during retreading. Thompson contour-shaped molds also eliminate possible damage to the air-tight seal of tubeless tires caused when the casing is forced into an off-shaped mold which was not specifically designed to maintain the original shape and contour of the tire when new. Unlike molds designed primarily to manufacture new tires, Thompson molds are designed expressly for retreading aircraft tires and do not require pre-shrinking distortion of casings before retreading.

The ability to repair a damaged casing is a second major factor in the preservation of a casing. Operating at high speeds under high air pressure and with limited skid depths and less cut-resistant material, all jet tires are inherently more susceptible to cutting from foreign objects and flat spotting than are conventional tires. Most such common damage can be repaired by Thompson and casings need not be scrapped. Based on extensive research of the physical and chemical properties of rubber as they apply to conditions of jet tire operation, Thompson has developed elaborate formulations and techniques for repairing damage while maintaining maximum safety factors.

Thompson determines the exact size and depth of casing damage in order to select proper rubber repair materials and establish the appropriate time, temperature and pressure for curing. Thompson has established specifications for reinforcement repairs when cuts extend into the ply. Reinforcements are a series of overlapping reinforcing plies installed on the inner side of the casing to re-establish the original tire strength factor.

Possible damage or cracks in the inner liner of tubeless tires is located by exact inspection, and repairs are made to maintain air impermeability and extend life of casing.

Bearing out the practical advantages to be gained from Thompson retreading, it is noted that the Boeing 707s on Pan-American World Airways trans-Atlantic flights are now operating on tires retreaded for the fifth time by Thompson.



THOMPSON JET-TRED ON BOEING 707

The Thompson techniques and specialized equipment described briefly above represent the sum total of 15 years of product development and provide the airlines with facilities unique in the retreading industry. Thompson is the one dependable source qualified to meet every retreading and repairing requirement with a reliable product realistically priced. Let Thompson determine the number of times your jetliner tires can be retreaded.

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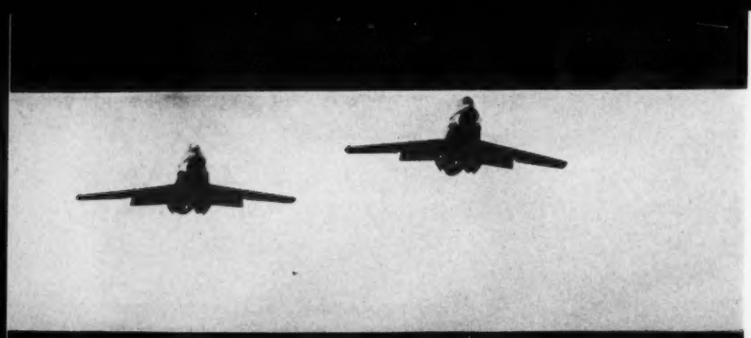

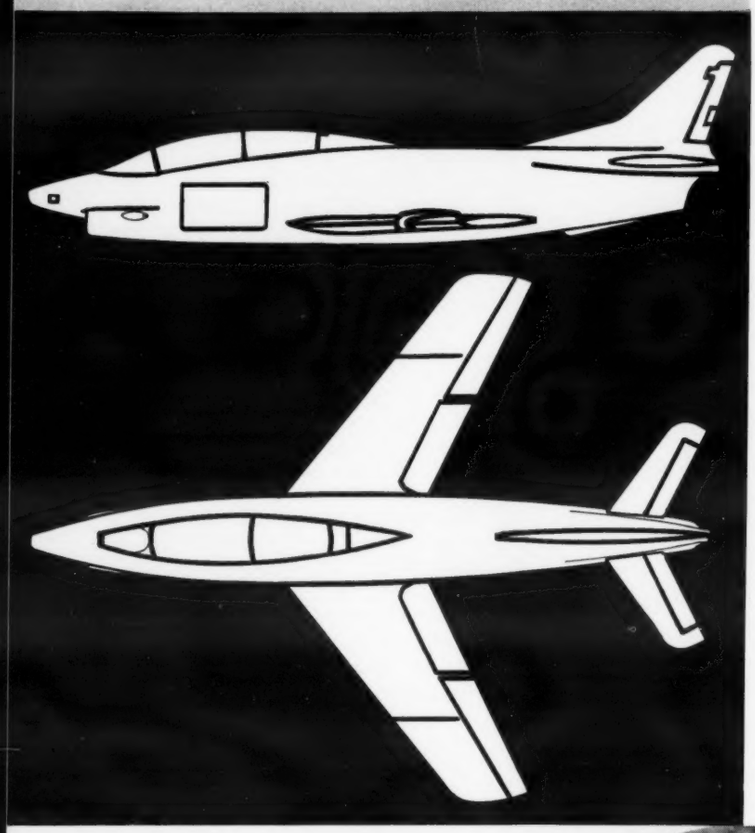

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FIAT G 91 T **Bristol Siddeley Orpheus 80 302**

The jet trainer, with characteristics and performance similar to those of the lightweight strike fighter version, is an aircraft especially developed for advanced training up to supersonic speeds. Meets all the requirements of the latest NATO standard and ABC agreements.

FIAT G 91
Bristol Siddeley Orpheus 80 302

The lightweight strike fighter, winner of the NATO contest. Basic advantages :

— small in size, light in weight, easy and comfortable to fly, ability to operate from a small space on semi-prepared strips or grass runways.

— maximum defensive and offensive efficiency with its basic and auxiliary weapons.

FIAT G 91 R **Bristol Siddeley Orpheus 80 302**

Photographic version of the lightweight strike fighter. It is capable of performing day missions at high speed and low altitude, taking photographs forwards, backwards and to right and left simultaneously, or vertical photographs.

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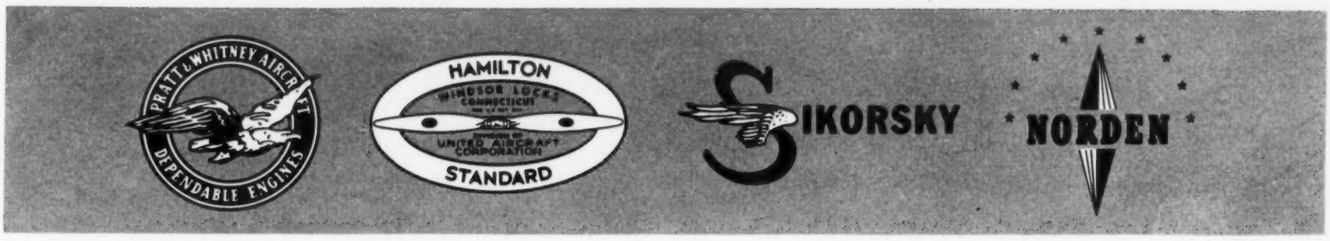

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INTERAVIA AIR LETTER reports...*

Minister of Aviation Duncan Sandys has indicated the British Government's interest in joining with other European countries to create an integrated air traffic control system covering western Europe. Britain will now cooperate with other European countries studying the legal and technical problems involved in setting up the Eurocontrol organization.

●

Passengers handled by Amsterdam-Schiphol Airport passed the 1-million mark in 1959, for the first time in the airport's history. The millionth passenger arrived by a KLM *Viscount* flight from London on November 5th.

●

In Norway a major programme of airport modernization is being pushed through to enable the nation's airports to cope with jet traffic. Oslo-Fornebu Airport is to have a new 8,200-foot east-west runway, scheduled for completion in 1961. New hangars and workshops are being built to cope with Douglas DC-8s, and there are also plans to build a large new passenger terminal and eventually also a large hotel. Bergen and Stavanger Airports are already large enough for jet operations, and Bödö will shortly be in the same position. Trondheim-Vaernes Airport is being extended by building out into the Stjörndals River and into the North Sea. The main runway will have a length of 9,186 feet, and the airport is scheduled for completion by the autumn of 1961. Estimated cost of the project is between 40 and 50 million Norwegian crowns ($5.6 to $7 million) ; the bulk of the cost will be paid by NATO, with the Norwegian Government contributing 3 to 4 million crowns for widening the runways for civil traffic.

●

The East German Lufthansa company carried a total 103,858 passengers on domestic services in 1958, compared with 34,278 in the previous year. The carrier reports an overall load factor of 64.1 percent in scheduled international traffic during the year. — It is now known that the entire capital of the East German Lufthansa company is held by the State and not, as was previously reported, partly by industrial and air transport undertakings. All operating profits and losses are transferred to the national budget.

●

Pan American World Airways will introduce, on January 1st, 1960, rate reductions averaging 50 percent on general air freight shipments between the United States and the Far East, together with a simplified method of application. The existing complex commodity-by-commodity rating system will be replaced by a single rate for all types of goods within each weight class (the heavier the shipment, the lower the rate per pound) with five weight classes. The rate per pound of a 22,000-lb shipment San Francisco-Tokyo is cut from the present $1.62 to $0.75 ; the rate for a 750-lb shipment New York-Hong Kong is cut from $1.91 to $1.17. PAA Vice President Traffic and Sales Willis G. Lipscomb said he believed that air freight traffic between the U.S. and Europe could be quadrupled within a few years if this system were to be approved by IATA carriers and their governments for the North Atlantic.

●

The Flight Safety Foundation, a private agency supported by 300 commercial and industrial concerns, is making a nation-wide study of safety in private aircraft flying operations. The Foundation has received a $77,600 grant from the National Institute of Health for first year work, the major objective of which will be to catalogue all the known facts and circumstances in light aircraft accidents. Approximately 50 percent of active aircraft in the United States are engaged in private flying ; this category also includes over two-thirds of United States active pilots, between them logging almost twice the aircraft mileage of the scheduled operators.

●

An American Express Travel Survey says that an estimated 13,000 Americans will make world tours in 1960 ; approximately 10,000 will travel by air, and the remainder by sea. It is forecast that air travellers will devote between four and eight weeks to the trip, at an average cost of $2,000 to $6,000. American Express estimates that of these individual expenditures at least $1,345 will be spent on air transportation.

Rolls-Royce engines are powering, or will power, 56 percent (817) of the 1,454 jet and turboprop airlines on order or in service in the world (excluding the Soviet bloc). Rolls-Royce's nearest rival is Pratt & Whitney, whose share is 21 percent (304 aircraft). The remaining 23 percent (333 aircraft) is divided among Bristol Siddeley, Allison and General Electric. The Rolls-Royce share in this world market is made up as follows : *Dart*—1,964 in 571 aircraft of four types ; *Conway*—292 in 73 aircraft of three types ; *Avon*—266 in 94 aircraft of two types ; *Tyne*—220 in 55 aircraft of two types ; RB.163—72 in 24 aircraft.

●

Philippine Air Lines has ordered a *Viscount V.745* from Vickers-Armstrongs Ltd., thus bringing *Viscount* sales up to 408. Value, plus spares, is £160 million.

●

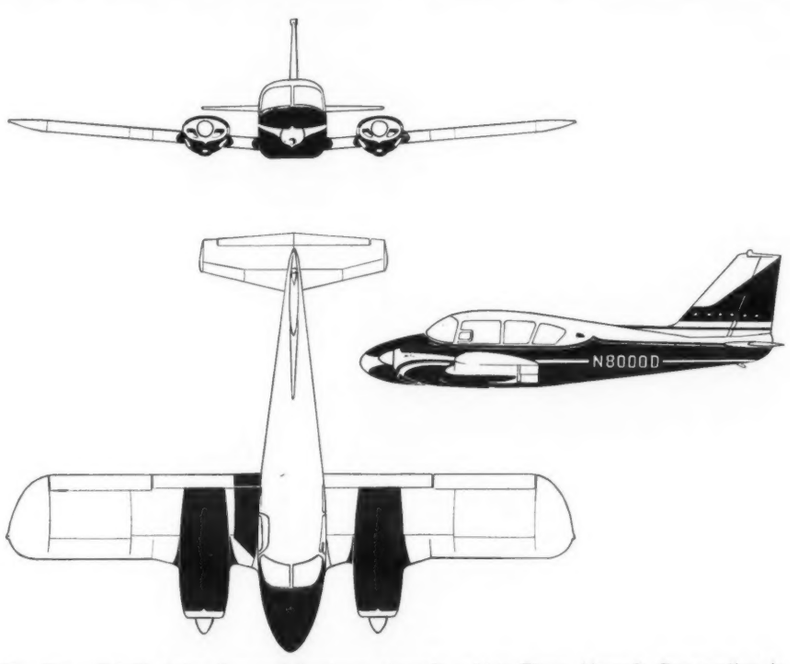
The 2,000th Marboré passed its acceptance tests at Turboméca's Bordes factory during October. The Marboré has now logged 197,000 hours flying time and a total operating time of 225,000 hours ; current overhaul life is 400 hours. The unit is equipping the *Magister*, the Morane-Saulnier MS.760 *Paris*, the Nord-Aviation 2502 *Noratlas* and the Nord CT.20 target drone.

●

Trek Airways, Dornier representative in South Africa, has sold six Do 27s since taking up the agency 18 months ago. Two of the aircraft are in service with the South African Air Force, two with Basutair (Basutoland charter operator), one each with the crop-spraying firms Zululand Fertilisers and Westelike Provinsie Oebespurting Maatskappy of Malmesbury, Cape. Trek also has a demonstration Do 27 at the Rand Airport, Germiston. The company's Sales Manager for Dornier, W. Fortuin, demonstrated the Do 27 to the Egyptian military authorities on a recent delivery flight to South Africa ; Egypt is reportedly considering manufacturing the Do 27 under licence.

●

Fuji Heavy Industries shipped the last two of 36 Japanese-built T-34 *Mentor* trainers on order for the Philippine Air Force from



The Piper PA-23 *Aztec* five-seat business aircraft, which Piper Aircraft Corporation is to begin delivering this month. Powered by two 250 h.p. Lycoming O-540 engines, the *Aztec* can reach a maximum speed of 215 m.p.h. Wing span 37 ft, all-up weight 4,800 lb. Sale price $49,500.

* Interavia Air Letter is a daily international news digest published in English, French ("Courrier Aérien") and German ("Luft-Post"). All rights reserved.

Yokohama on October 28th. The T-34s were built under a licence agreement with Beech Aircraft Corporation and have been delivered to the Philippines as part of Japan's reparations payments. Fuji Heavy Industries is anticipating an order through C. Itoh & Co. for about 40 T-34s for the Indonesian Air Force. Reports from Indonesia indicate that the Government will shortly select the T-34 as a primary trainer for the Air Force, following competition with the Polish TS-8 *Bies*.

●

Lockheed Aircraft Corporation has received a $19.2-million U.S. Navy contract for an unspecified number of GV-1s (Navy version of the C-130B *Hercules*) for the Marine Corps ; the aircraft will be manufactured at Lockheed's Marietta, Georgia, plant. The GV-1 will have dual roles as an aerial tanker and an intra-theatre assault transport. In the tanker version the GV-1 can transport 28,000 lb of fuel for multiple refuelling of jet aircraft at ranges of 1,000 miles ; as a transport, it can carry 92 combat-equipped marines, or 74 litter-patients, or 35,000 lb of cargo over ranges of 2,000 n.m. at a speed of 300 knots. — Lockheed will supply ten C-130B *Hercules* to the Indonesian Air Force, with deliveries to start in 1960.

●

Orders for the Douglas DC-8 now total 150 aircraft, broken down by carriers as follows : Alitalia 4, CPAL 4, Delta 6, Eastern 16, Iberia 3, JAL 4, KLM 12, National 3, Northwest 5, Olympic 2, Pan Am 17, Panair do Brasil 4, Panagra 4, Philippine Air Lines 2, SAS 7, Swissair 3, TAI 2, TCA 10, United 40, UAT 2.

●

Republic Aviation Corporation reports that its backlog at September 30th was $500 million, representing orders for : the F-105 *Thunderchief* fighter-bomber, related support equipment and technical data ; advanced surveillance drones ; inertial guidance control systems for missiles ; complex AMM study contracts ; and contracts for research and development in astronautics. President Mundy I. Peale said that the Mach 2 F-105 is now in operational service with Tactical Air Command; two squadrons have already been formed and others are in course of formation. The first all-weather model F-105D was completed weeks ahead of schedule and is now going into production.

●

Japan's National Defense Council has selected the F-104CJ (J = Japan) as the replacement fighter for the Air Self-Defense Force. The Government's statement says that it has been decided to manufacture in Japan 180 Lockheed F-104CJs and 20 two-seat F-104B trainers by 1965. It is almost certain that Mitsubishi Heavy-Industries will be named as prime contractor, with Kawasaki Aircraft as sub-contractor ; it is forecast that production will begin in the summer of 1961.

●

The U.S. Federal Aviation Agency will test for adaptability to civilian use a new air traffic control system at present under development for the Air Force by Crosley Division of the Avco Corporation. Designated Volscan (volumetric scanning), the system is intended to reduce traffic delays for inbound aircraft at busy airports and can simultaneously direct 18 inbound and 6 outbound aircraft.

●

The managements of Boeing Airplane Company and Vertol Aircraft Corporation have agreed a merger of the two companies under plans calling for the issue of two Boeing shares against three Vertol. The two Presidents, William M. Allen and Don R. Berlin, are to submit the proposal to shareholders for approval. Vertol's current activity would continue, but the company would in future be known as Vertol Division of Boeing Airplane Company.

●

Pan American World Airways marked 12 months' Boeing 707 New York-London operations on November 16th. During the first year's operations, Pan Am's Boeing 707s have flown 800 million passenger-miles on the North Atlantic, and have carried 204,000 passengers, 3.3 million kilogrammes of cargo and mail and logged a total of 7,025,630 miles with an average passenger load factor of 90.5 percent. In the nine months ending September 30th, Pan Am's Atlantic Division showed a net profit of $13.5 million.

●

Lufthansa has acquired an additional 69 percent holding in the West German charter operator Deutsche Flugdienst A.G., taking over the stock previously held by Deutsche Bundesbahn, Norddeutsche Lloyd, Hamburg Amerika Line and Deutsche Dampfschiffahrts-Gesellschaft Hansa. Lufthansa will have a majority holding with effect from November 25th, 1959. No organizational changes are planned and Deutsche Flugdienst will continue to develop its very successful charter business for tourist flights ; Lufthansa's aircraft will be made available to the company if required.

●

The Mitsui Bussan Company is to supply ten Kappa 6 rockets to Yugoslavia for non-military experimental work. Professor Hideo Itokawa of Tokyo University, inventor of the Kappa rocket, said that Yugoslav delegates to the International Rocket Conference held in Amsterdam last year had shown considerable interest and had invited him to explain its capability. The Kappa 6 is 19.3 ft long, has a weight of 595 lb and is capable of attaining an altitude of 37.2 miles. The order is valued at 100 million yen (approximately $277,000). The Kappa 6s will be manufactured by the Fuji Precision Machinery Company.

Workshop Briefs

The first Lockheed C-130 Hercules to be experimentally fitted with a boundary layer control system was recently rolled out. This STOL C-130, whose all-up weight is 100,000 lb, reportedly has a take-off run of about 610 ft and a landing run (at the same landing weight of 100,000 lb) of only 460 ft, even from semi-prepared strips.

●

The Pratt & Whitney JT3D turbofan engine (17,000 lb thrust), installed experimentally in a North American RB-45, completed over 50 hours during flight tests. The first production JT3D will be available in summer, 1960.

●

The de Havilland Sea Vixen and the Folland Gnat will be the first British production aircraft to be fitted with liquid oxygen breathing systems as standard equipment. A number of sets has just been ordered from British Oxygen Aro Equipment Ltd. following the placing of a development contract with the company.

●

The third Goodyear ZPG-3W non-rigid airship began flight testing in October and is to be handed over to the U.S. Navy this month. Goodyear also announces that a fourth ZPG-3W is under construction. The ZPG-3Ws, powered by two 1,525 h.p. Wright *Cyclone 9* R-1820-88 engines, carry comprehensive electronic equipment and serve primarily for early warning purposes. The crew consists of 21 men.

●

Electronic Associates, Inc., whose European Division is located at Brussels, has developed a low-priced analogue computer, the PACE TR-10, weighing only 79 lb ; fully transistorized, it is accurate to within 0.1 percent, its dimensions being approximately those of an electric typewriter (15×17×14 in.). Its fields of application are aeronautics and astronautics.

●

The 1370th Photo Mapping Group, Air Photographic and Charting Service (MATS), Albany, Ga., has received 15 of the new Lockheed RC-130 aircraft. The RC-130 has been undergoing tests for nine months, during which errors of less than one foot in distances of eight miles were recorded.

●

The first Cessna T-37B twin-jet intermediate trainer was delivered to the U.S. Air Force on November 6th, 1959. The B version of this trainer differs from the earlier T-37A in having two Continental J69-T-25s of 1,025 lb thrust each (instead of 2 × Continental J69-T-9s of 920 lb thrust) and more advanced communications and navigation equipment. Before turning out its first T-37B, Cessna produced 416 T-37A trainers for the Air Force, and these are being converted to the B model. Cessna will modify an average of 33 aircraft per month ; completion of the programme is scheduled for July, 1960.

●

A new type, high-level platform to be used in the maintenance of U.S. Army aircraft is being developed by the Aircraft Equipment Division of Consolidated Diesel Electric Corporation. The unit is designed for mounting on a standard Army M-37 truck. Power taken from the truck's electrical system will drive an electric motor which raises and lowers the platform by means of a winch and cable mechanism. The unit, which is air transportable, will weigh approximately 600 lb.

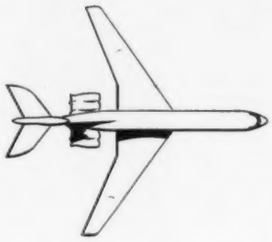
●

Preliminary details of a new turbine-powered helicopter, the HR3S-1, were announced by Sikorsky when a full-scale static model was demonstrated to RCAF officials on November 3rd, under the auspices of Canadian Pratt & Whitney Aircraft of Montreal. The HR3S-1 is an adaptation of the U.S. Navy's HSS-2, which is now in production at Sikorsky's Stratford, Connecticut, plant. It was also announced that Canadian Pratt & Whitney has concluded agreements with Sikorsky to produce a substantial portion of the HR3S-1 in Canada for Canadian military orders. — The HR3S-1, with rear loading door, has (like the HSS-2) an amphibious hull, retractable landing gear, all-weather flight capability and automatic stabilization equipment. Power-operated rotor-blade folding, which is incorporated in the HSS-2, will be optional on the HR3S-1. Power is provided by two General Electric T58 gas turbines of 1,250 s.h.p. each.

●

The pre-production batch of Dassault Mirage IIIs is powered by SNECMA *Atar 9* turbojets with a thrust of 13,230 lb with reheat. The production *Mirage IIIs* will be fitted with an *Atar 9C* version which will have an all-steel compressor rotor and raise the sea level thrust to 14,110 lb. A *9D* version of the *Atar is* also planned, with a sea level thrust of 14,990 lb.

THE SHAPE OF THE FUTURE



The wing

is free

to do its job

because . . . .

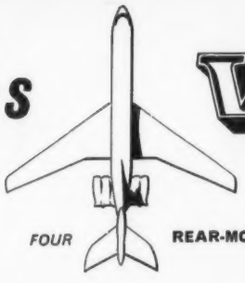
the engines are in the right place

The airline silhouette of the future, with its clean wing and rear mounted engines, offers many important advantages:

- The clean wing has higher lift and lower drag, giving superior airfield performance and better high mach number characteristics
- Full span leading edge lift devices and uninterrupted flaps
- Much reduced fire risks with no tanks or fuel lines in turbine disc areas
- Better performance margins and unique payload/range capabilities
- Greatly reduced cabin noise
- No handling problems in critical engine-out situations
- High-set engines with minimum debris risk
- Simpler maintenance from better systems access
- Reduced engine mounting structural difficulties

For the above, and for many other reasons, rear-mounted engines represent one of the greatest advantages in aircraft layout.

VICKERS **VC10**



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AR-108 VHF Receiver

- Single crystal channel, 108-156 Mcs.
- Completely transistorized
- Modularized plug-in circuitry
- Compact size—permits two units to be mounted side-by-side in std. 19" rack
- Low power drain and heat dissipation
- Indefinite component life expectancy
- Simplified servicing and testing procedures

TAG-108 VHF Transmitter

- Two crystal channels with 1 Mcs. spacing over 108-156 Mcs. frequency range
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NOW
THE STOL* HERCULES

* short take-off and landing

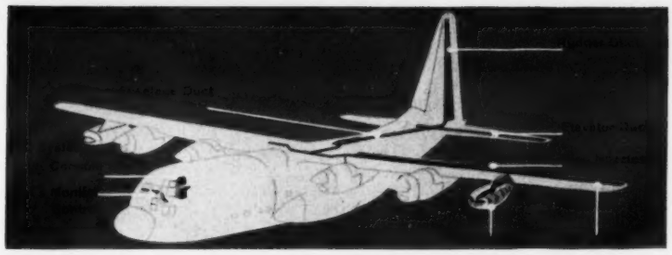
A boundary layer control system, which will spectacularly shorten the already astonishingly brief take-off and landing runs of Lockheed's versatile 67-ton C-130 Hercules transport, is now in an advanced stage of development.

The Lockheed BLC system culminates many years of study by Lockheed engineers and follows four years of research devoted to specific application of the system to the Hercules.

Four auxiliary jet engines, weighing only 500 pounds each, will furnish the streams of high pressure air which flow over wing, empennage and flaps to decrease STOL speed. They can quickly be removed when BLC is not needed.

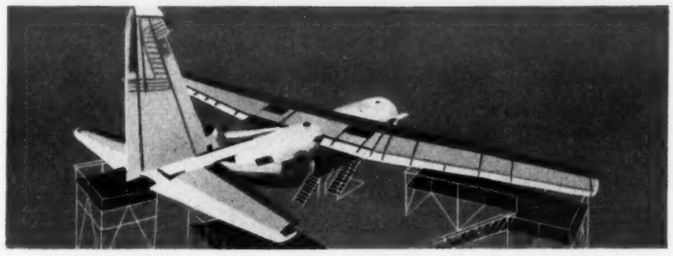
Manufacturing work on the BLC Hercules can begin now because 80% of the airplane is identical to the C-130 B. In Europe, a nation or group of nations could manufacture the C-130 B and have a European version flying in 1961—less than half the time required by a new untested design. The program could then be phased into the more advanced BLC Hercules. Know-how acquired by Lockheed in manufacturing nearly 300 C-130s to date can make the BLC Hercules European manuf cturing project the most rapid and inexpensive answer to the needs of European nations for a high performance, all-purpose transport.

As a combat transport of men and equipment the C-130 showed its superlative value in airlifts to Lebanon and Turkey.



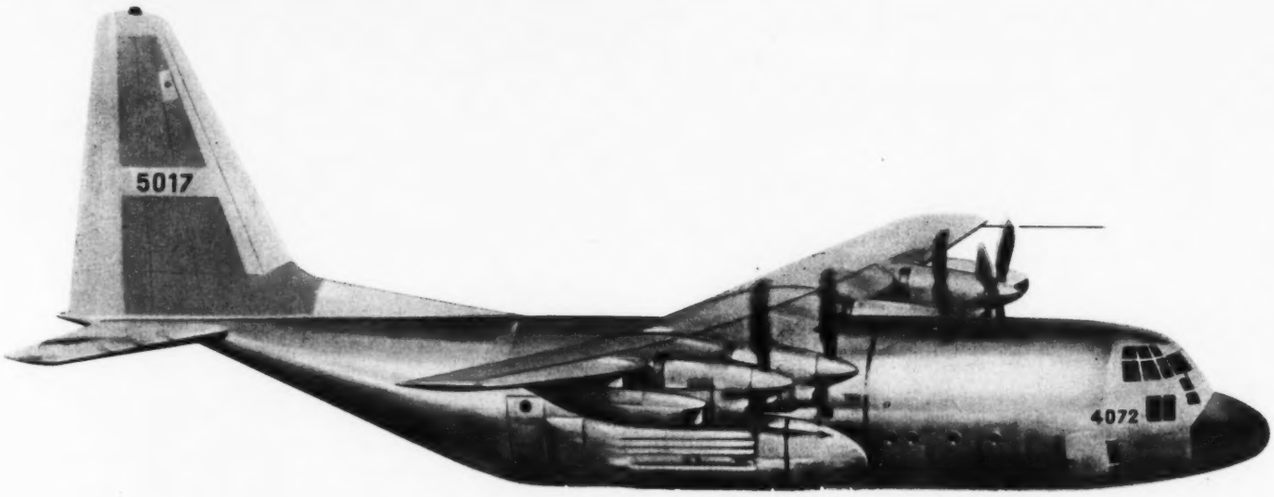
Boundary Layer Control

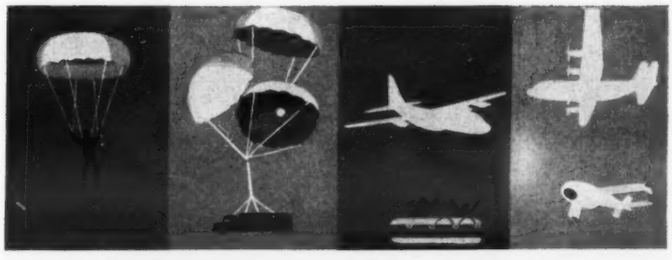
This illustration shows the Boundary Layer Control system of the Hercules. A pod under each wing carrying two small modified jet engines bleeds air which flows over ailerons, flaps, rudder and elevator greatly reducing stall speed of the 67-ton transport.



Licensed manufacture

The Hercules is easily adapted to licensed manufacture. Plans for its production in Europe by a nation or nations cooperating with Lockheed have been carefully studied. Results emphasize spectacular saving of both money and time to countries engaged in such a joint enterprise. The Hercules could be produced in Europe in less than two years.





Versatility

The excellent range capabilities of the C-130 enable it to perform long search and patrol missions. Moreover, it can be easily adapted to many different mission configurations including Paratroop Drop, Aerial Cargo Delivery, Air Rescue, Drone Launcher / Director Aircraft, Troop Carrier, Air Refueling, Aerial Mapping and Surveying, etc.

Soft Field Take-off and Landing

The unique landing gear design of the C-130 permits it to operate from soft, unprepared fields. High gross-weight landings and take-offs have been made on grass, sand and pierced steel plank. The C-130 is the largest aircraft to be equipped with skis for snow and ice landings.

Jet Transports - Jet Fighters - Jet Trainers - Commercial & Military Prop-Jet Transports - Rocketry Ballistic Missile Research & Development - Weapon System Management - Anti-Submarine Patrol Aircraft Nuclear-Powered Flight - Advanced Electronics - Airborne Early-Warning Aircraft - Airport Management - Nuclear Reactor Design & Development - Ground Support Equipment - World-Wide Aircraft Maintenance

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AND TACTICAL MOBILITY

How to overcome the impact of atomic arms on lines of communication? How, rapidly, to re-align the supply services in a tactical dispersal? How to keep it coming through refugee-ridden desolation? Get it off the ground. Lift it in one swift stride from depot to forward area. Avoid the roads and the fixed target areas. If it won't fit inside, hang it underneath and put it just where you want it. Carry troops, ammunition, stores, vehicles, aircraft, casualties, bridge spans, commanders, at up to 200 m.p.h. *How? By Rotodyne.*

N.B. 9 Rotodynes and 18 men replace 166 3-ton trucks and 166 drivers.

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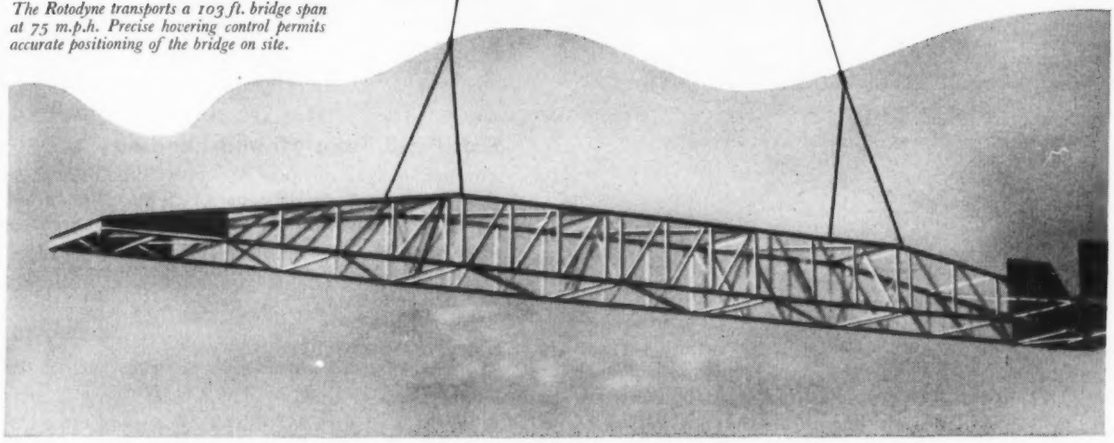
The Rotodyne transports a 103 ft. bridge span at 75 m.p.h. Precise hovering control permits accurate positioning of the bridge on site.



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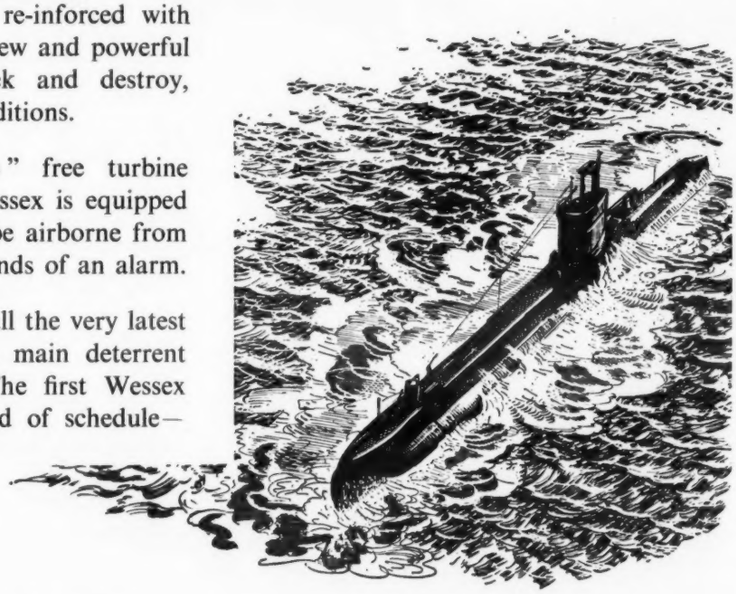

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India Looks Ahead

The aircraft industry

When, last July, the Indian Government signed an agreement with Hawker Siddeley Aviation Ltd. for the licence manufacture of the Avro 748 in India, this meant more to the Indian industry than the mere acquisition of production rights for a medium-stage turboprop transport.

Under present plans, the Indian authorities do not intend that this aircraft shall be manufactured by Hindustan Aircraft Ltd., of Bangalore, Mysore, but at Kanpur, Headquarters of the Indian Air Force Maintenance Command, some 180 miles from New Delhi. This is the first time that the monopoly held by Hindustan Aircraft since its creation in 1940 has been challenged. And the — perhaps intentional — shock effect of this measure on the company's management has led to feverish activity on the part of the project office.

The result is a considerably enlarged development and production programme which fully merits the description "impressive."

Now *in production* at Hindustan are the Folland *Gnat* strike fighter (quantity production contract awarded last July), the two-seat de Havilland *Vampire Trainer* (in production since 1952) and the *Pushpak* light two-seat sports aircraft which is offered to the Indian flying clubs at the price of 20,000 rupees (roughly $4,000) under a "fly as you pay" extended payments scheme. Production of Hindustan's HT 2 light piston-engine trainer appears to have come to a standstill, at any rate for the time being. On the engine side, the production line for the Bristol *Orpheus* jet engine, licence manufacturing rights to which were acquired in 1955, is now ready, and small 85 h.p. and 150 h.p. piston engines of the company's own design are also being turned out.

The list of *projects* for the more or less distant future is a long one. It is headed by the HF 24 supersonic fighter designed by Professor Kurt Tank and to be powered by two *Orpheus Mk.12* engines built under licence by Hindustan. A four-seat sports and touring aircraft mentioned is probably a development of the *Pushpak*, and an eight-to-ten seater, now in the early design stage, will reportedly have propeller turbines. There is also a project for a jet trainer, possibly derived from the HF 24 fighter, and finally there is talk of licence manufacture of a high-performance jet engine and of the development of a guided missile; the latter, however, will still need long preparatory work.

All this, together with parts manufacture, overhaul of military and civil aircraft and extensive activities in non-aeronautical fields (rail coaches, bus bodies, small motor cars, etc.), adds up to a production and development programme of such vastness that Indian aeronautical circles are asking how Hindustan will be able to cope with it. Incidentally, this is not the first time the question has been raised. A list of projects published early in 1957 aroused the comment that Hindustan looked like having "too much on its plate."

It would, of course, be too easy to dismiss this ambitious and evidently tentative planning as unrealistic. Fundamentally the Indian aircraft industry is now roughly in the same stage as were the Western European manufacturers immediately after World War II. In Europe too this period was marked by a flood of projects and prototypes, of which very few ever reached production status. But later experience revealed that the prototype fever definitely had a beneficial effect on subsequent serious developments.

What are the prospects that the more deserving designs will ever go into production? Financially speaking, Hindustan Aircraft Ltd. is in fairly good shape. During the 1956-57 business year, it recorded a net profit of 3.2 million rupees (roughly $640,000) and in 1957-58 3.4 million rupees ($680,000). The company has modern, well-equipped plant and efficient personnel—at any rate in the higher echelons. Considerable anxiety, however, is felt about the shortage of engineers and skilled workers, a problem which seriously preoccupies not only the aircraft manufacturers but also the whole of industry in India. As regards Hindustan Aircraft in particular —which is now a State-run company—the situation is aggravated by the fact that the salaries paid are not always attractive, and many skilled men have left for other employment. However, India is doing everything possible to remedy the chronic shortage of trained personnel, and anyone visiting European or American courses for foreign aeronautical engineers will note a high percentage of Indians among students.

It goes without saying that the Kanpur facility is encountering the same difficulties as Hindustan Aircraft. Reporting on a personal interview with Defence Minister Krishna Menon (and on a statement by Air Vice-Marshal Harjinder Singh, Air Officer Commanding Maintenance Command), *Interavia's* Bombay correspondent writes that it seems very doubtful whether the schedule for Avro 748 production, which calls for the delivery of 50 to 60 aircraft annually from 1964 onwards, can in fact be maintained. However that may be, the rate at which any project advances must depend largely on military requirements. In view of the present situation on India's northern frontier, some speed-up can perhaps be expected.

Air transport

Rumours that J. R. D. Tata was planning to resign as Air-India Chairman—rumours which began circulating after his return from the IATA Annual General Meeting in Tokyo—have since been officially denied. This will doubtless be a great relief to the Indian overseas airline. In view of the company's plans to introduce jet services next spring—three Boeing 707s are to be delivered very shortly—this is not the ideal time for any drastic change in the management. J.R.D. Tata is known as having built up the company, pulled it out of the red and led it to international esteem. Quite apart from these considerations, it would have been difficult to find a replacement. The number of Indians available and of sufficient standing to run an airline of the Air-India calibre can be counted on the fingers of one hand. For example, the Government has been unable to find a businessman qualified and willing to take over the responsibility of running Indian Airlines Corporation, the domestic carrier. And to have a Civil Servant in the post is not regarded in New Delhi as an ideal solution.

Even without any change in management, Air-India will have a number of problems to face in the coming year. Though revenue rose from 108 million rupees in the 1957-58 business year (April 1st to March 31st) to 116 million rupees in 1958-59 (i.e. from approx. $22 to $23 million), net profit for the same years fell from 7.2 million rupees ($1.4 million) to 1.6 million rupees ($330,000). What is more, the revenue load factor dropped from 59.1 percent to 56.8 percent, as there was not sufficient traffic demand to make good for the 11 percent increase in capacity.

As capacity will be still further increased when the Boeing 707s are put into service, ways and means must be found of augmenting traffic volume, so as to avoid losses. One step in this direction is the introduction of credit travel (20 percent down payment and 15 monthly instalments), which was applied to existing services at the beginning of October 1959 and will be extended to the new jet services in April 1960.

Meanwhile, the U.S. Civil Aeronautics Board has announced that Air-India's request for a service to New York, via London, has been granted. In other words, the basic conditions for jet operations have now been provided, and the only serious problem remaining is the shortage of personnel—a shortage which is just as acute in air transport (flight crews and ground services) as in industry.

INTERNATIONAL MEETINGS AND CONFERENCES

Nov. 29th-Dec. 4th : American Society of Mechanical Engineers, Annual Meeting. Atlantic City, N.J., U.S.A.

Nov. 30th-Dec. 4th : Fourth Annual Naval Air Weapons Meet, Operation *Top Gun*. Yuma, Ariz., USA.

Dec. 1st-3rd : Eastern Joint Computer Conference. Boston, Mass.

Dec. 1st-22nd : ICAO Facilitation Division, 5th Session. Rome.

Dec. 2nd : Aeronautical Radio Inc. and Arinc Research Corporation, Board of Directors Meeting. Washington, D.C.

Dec. 7th-8th : Classified Symposium on "The Plasma Sheath, Its Effect on Communication and Detection." Sponsored by Electronics Research Directorate, Air Force Cambridge Research Center. Boston, Mass.

Dec. 7th-11th : National Conference on the Application of Electrical Insulation. Sponsored by American Institute of Electrical Engineers and National Electrical Manufacturers Assn. Washington, D.C.

Dec. 8th-9th : Southwest Society of Aircraft Material and Process Engineers, First Aerospace Finishing Symposium. Fort Worth, Texas.

Dec. 10th : Institution of Production Engineers, 1959, Sir Alfred Herbert Paper : "Production Engineering Developments in Russia," by Dr. D. F. Galloway. London.

Dec. 11th : Symposium on Flight Safety. Royal Aeronautical Society. London.

Dec. 11th : Royal Aeronautical Society, Agricultural Aviation Group : "Aerial Operations Planning in the United Kingdom : Results and Difficulties," by Peter King. London.

Dec. 15th : ATA Board of Directors Meeting. Washington, D.C.

Dec. 16th : ATA Membership Meeting. Washington, D.C.

Dec. 17th : 23rd Wright Brothers Lecture : "High Temperatures in Hypersonic Flow — Physical Principles and Experimental Techniques," by Dr. Alexander Flax. Washington, D.C.

Jan. 7th-10th : Fourth International Symposium on Radioactive Isotopes. Bad Gastein, Austria.

Jan. 12th : Royal Aeronautical Society, 94th Anniversary Lunch. London.

Jan. 14th-16th : Agricultural Aircraft Association, 10th Annual Convention. Palm Springs, Calif.

Jan. 19th IATA Composite Agency Committee. New York.

Jan. 19th : IATA Traffic Conference 1 Agency Committee, 29th Meeting. New York.

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New York Finance Notes

The Renegotiation Headache in the U. S. Aircraft Industry

BY SCOTT HERSHEY, NEW YORK

The aircraft manufacturing industry, already beset by a new series of Pentagon cutbacks, by the Government warning that it will no longer hand-hold ailing firms with contracts just to keep facilities in readiness for an emergency, and by the multi-faceted problems in the emphasis on missiles, has still another financial problem which has been largely overlooked—the extension of the Renegotiation Act.

This extension for three years casts a shadow over the industry's earnings and from an investment standpoint it is something to be considered in evaluating the equities, not only of the aircraft manufacturers, but also of those engaged in the more exciting business of missiles and space vehicles.

One Wall Streeter remarked recently that the aircraft business is the only one which is in a recession. And he had grounds for his remark. Among the 15 largest companies, sales have slipped about five percent and, more to the point, profits have tumbled about 45 percent.

At current rates, aircraft profits will drop from about $614 million last year to about $350 million this year. One may ask whether an industry earning $350 million has cause for worry. The answer in this case, of course, is that it does. Stocks are purchased on earnings outlook, and almost all aircraft earnings continue to nose downward. Compared with their 1959 highs, virtually all aircraft stocks are down.

New lows have been registered recently by a number of aircrafts including United Aircraft, Northrop, McDonnell, Bell and Temco. Meanwhile, as an indication of the way things are going, Douglas dropped from 59 3/4 to 46 ; North American from 52 5/8 to 37 3/4 ; Grumman from 30 3/4 to 24 3/8 ; Martin from 62 3/4 to 38 3/4 and General Dynamics from 66 1/2 to 48 1/2 ; and there are others.

Investors are worried not only about the falling profits, but also about indications that heavy cutbacks are on the way. A sizeable cutback for a middle-sized company that has most of its backlog tied up in a few contracts can bring it pretty close to disaster. Gone is the day when a company could win a contract for a new aircraft and look forward to several years of mass production with accompanying profits.

Add to these woes the Renegotiation Act extension. Since the passage of this Act in 1951 following the outbreak of hostilities in Korea, the major aircraft companies have had to make substantial refunds on past earnings. The total is over a hundred million dollars, and the end is not in sight since not all results of the 1951-1956 period have been examined, and few of those of recent years have gone through the renegotiation wringer.

The Act applies to any contractor which does $1 million of defense business with the Government, and that pretty well covers the field. It is estimated that about $20 billion of the $24 billion current annual military procurement is renegotiable.

Filings under the Act are running at the rate of about 4,500 a year, since the military contracts assigned by the Atomic Energy Commission and the National Aeronautics and Space Administration are subject to statutory review just as are the Pentagon contract awards.

A case in point which may have an effect on the whole problem is one before the Tax Court in which the Renegotiation Board seeks a $10 million refund from Boeing for 1952. The Board, in its findings, held that Boeing earned 92.8 percent on its net worth in 1952, reflecting the Government's substantial interest in the company's plant facilities. It was Boeing's contention that its earnings as a percentage of sales were a modest 7.6 percent.

Proponents of the Renegotiation Act point out that the Government has an investment of some $2.5 billion in plant and facilities, giving the Government a 65 percent interest in the aircraft industry's total plant and facilities. The industry contends it has been making material commitments of its own in facilities to the extent resources permit. The industry further contends that even were the facilities which are currently owned by the Government to be financed by industry, the resultant costs could become added charges to military procurement.

Some companies are even plotting their future on the theory that their present projects will be cancelled out. While this undoubtedly is wise management, it does not give the investor too clear a picture of the future and of future earnings.

Aircraft manufacturers have been obliged to learn new skills connected with supersonic flight, missiles and space vehicles, and this has meant the expenditure of vast sums for research. These expenditures must come largely out of profits, instead of from the Government, as in the past. And despite this outpouring of cash the manufacturer has no assurance that he will win the bulk of the defense business.

Just one item points this up. The number of electronic companies has leaped from 100 to about 2,000 in the last several years. Size alone is no guarantee that an aircraft company can compete with the newcomers in the field with their flexibility and low overhead.

The possibility of refunds under the Renegotiation Act further complicates the picture and dims the profits prospects. While the Board points out that it has recaptured some $723 million which it labeled "excess profits," and an additional $818 million in voluntary refunds, the industry challenges these figures. It cites huge costs for living up to the law, multiplied by investigations and litigation expenses attendant upon the growing number of appeals filed with the Tax Court. Industry also contends that the Board's record has been built in part by recapturing savings realized by more efficient operators, in the process discouraging the drive toward lower production costs.

It does appear that aircraft profits should be measured on a basis different from that applied to other industries. The complexity of aircraft and missile production must be considered in weighing the reasonableness of earnings. Few other industries are required to concentrate so speculatively on the development of a limited type of revolutionary products over a long period without the assurance that the products eventually will be purchased.

The cycle of a new type of supersonic aircraft or missile from conception to prototype may consume years. At no time, however, is the contractor entirely certain that the aircraft or missile actually will reach production.

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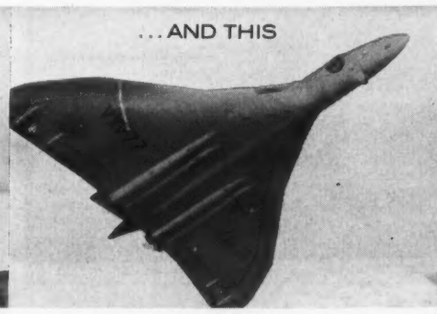
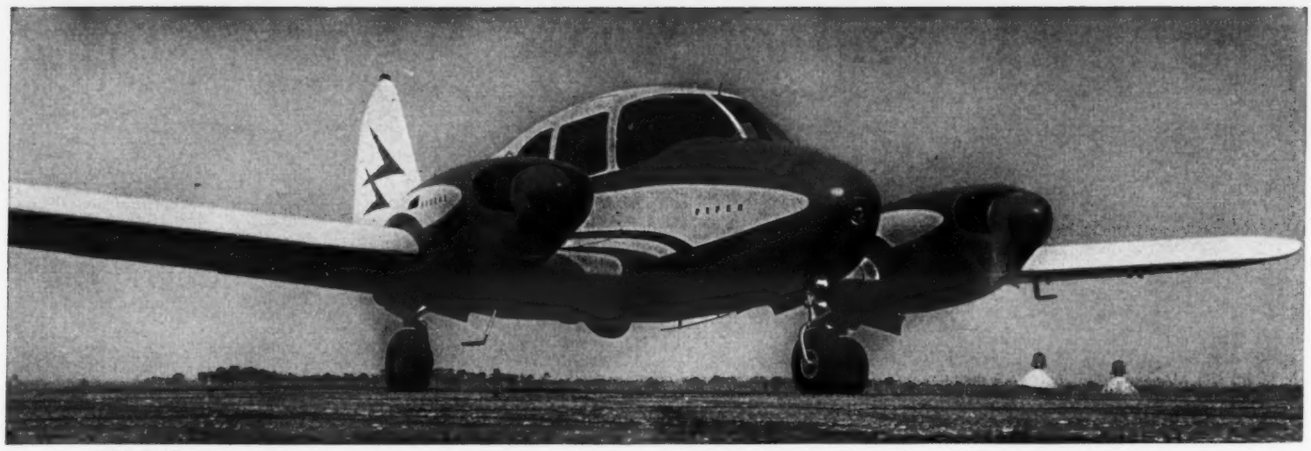


The Bristol Siddeley Olympus powers the Avro Vulcan V-Bomber.

Bristol Siddeley Maybach diesels power British Railways diesel hydraulic locomotives.



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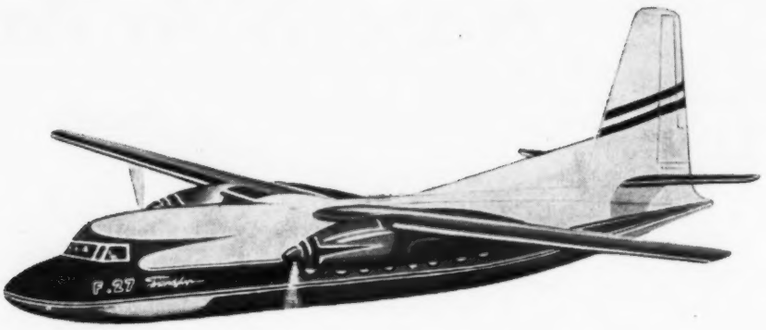

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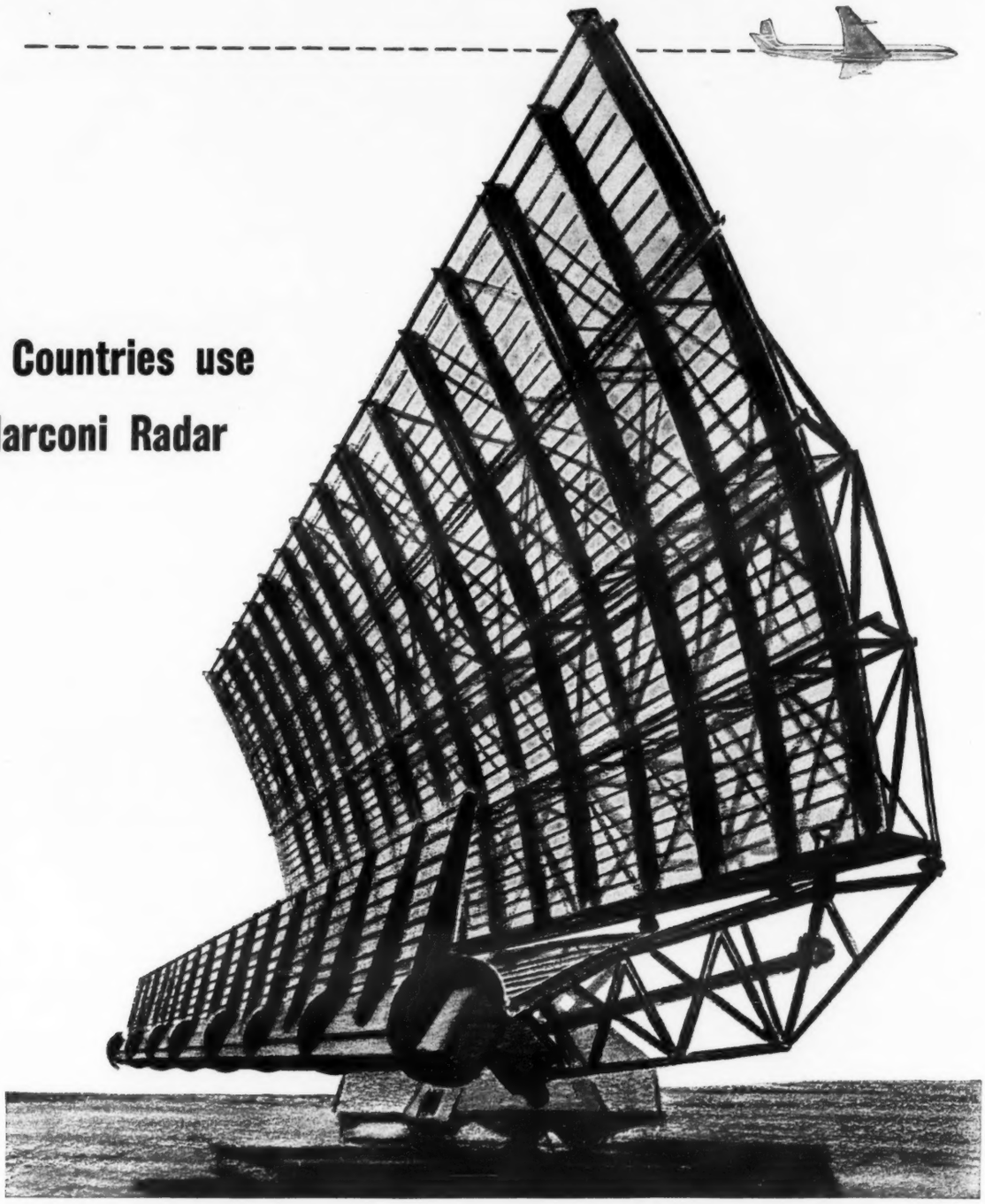

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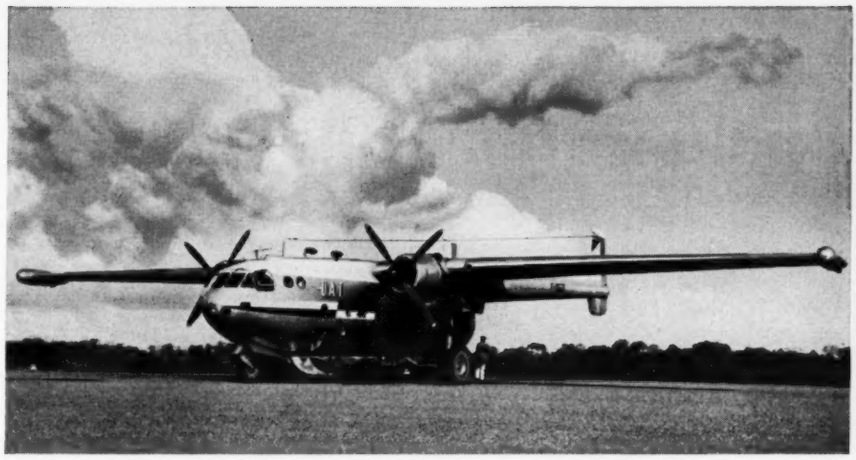

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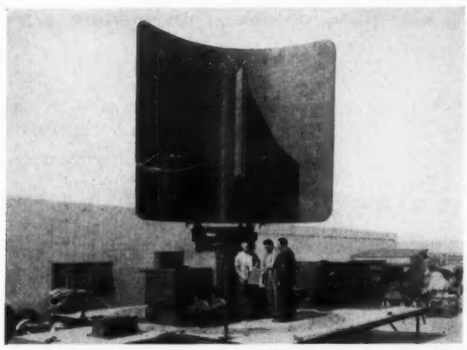

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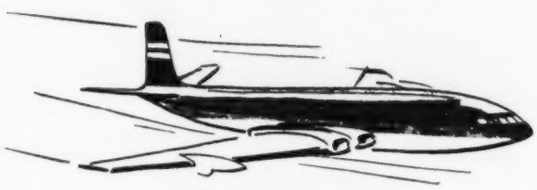

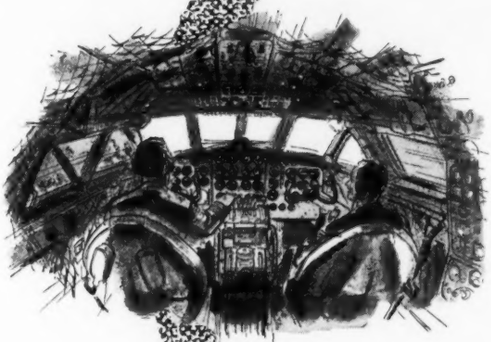

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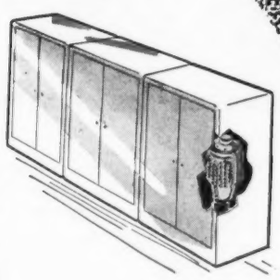


Computer and memory drum - calculations and conflict search

Principal features of SATCO:

Automatic coordination between control positions
Automatic flight data display systems
Extensive facilities for civil/military coordination
Special calculations for turbine aircraft
Special pre-departure facilities for air line operators
Uses latest type digital computers, fully transistorised
Fail-safe and self-checking.

Flight planning

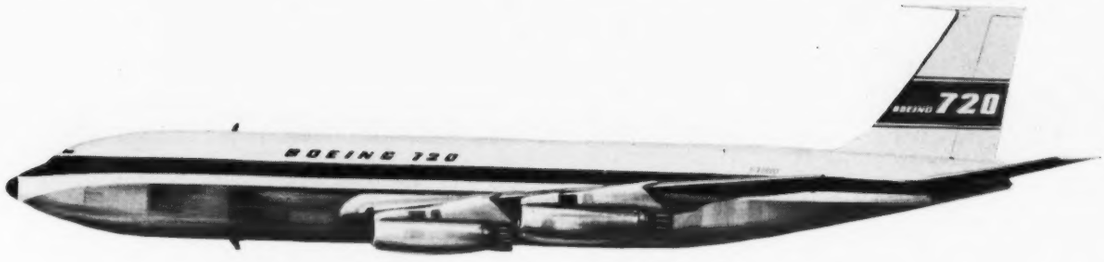
SIGNAAL

N.V. HOLLANDSE SIGNAALAPPARATEN HENGELO - NETHERLANDS

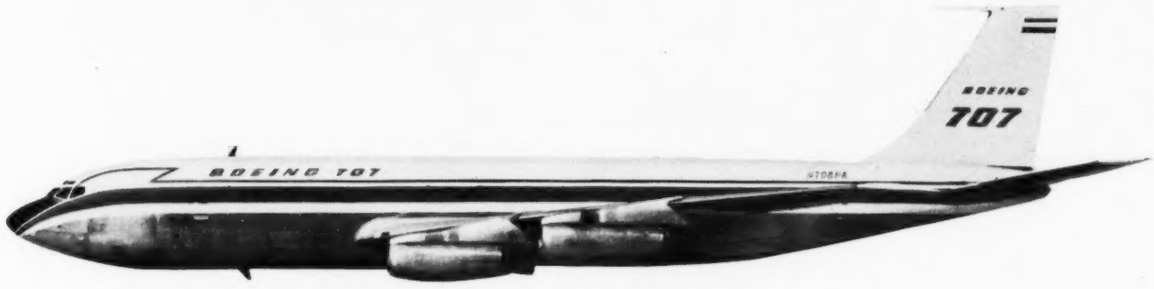
Whether it's at one end, as in the quietly efficient Westland Wessex... whether it's at both ends, as in the outstanding Bristol 192... whether it's upright, horizontal or in any position in between, the Napier Gazelle free turbine engine will always satisfy the exacting demands of helicopter operation. Designed specifically for helicopter application, the Napier Gazelle, with its " any angle " installation, relieves the designer of many accepted limitations and gives him more opportunity to make proper use of fuselage space. The Napier Gazelle 1,650 s.h.p. free turbine was the first gas turbine engine in the world to receive Ministry of Supply 150-hour Helicopter Type Approval.

NAPIER GAZELLE **FREE TURBINE ENGINE**

D. NAPIER & SON LIMITED, LONDON, W.3. A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP



BOEING 720 SHORT-TO-MEDIUM RANGE



BOEING 707 MEDIUM-LONG RANGE

BOEING 707 *Intercontinental* VERY LONG RANGE

Airline profit-makers

The Boeing jetliners shown above are designed for profitable operations over all airline routes, from short intercity segments to very long overocean stages.

Their outstanding earning power has already been demonstrated by the 707. Since going into service in October 1958, this Boeing jet has attracted unprecedented load factors of 90 to 95%. Operators describe it as the most popular airliner in aviation history.

The 707 Intercontinental—the world's fastest, longest-range jetliner—is now in commercial operation. With a range of more than 5000 miles with full passenger payload, it will fly nonstop over the longest stages of airline routes, at cruise speeds above 600 miles an hour.

The 720 is the fastest airliner of its class, with a cruise speed of 614 miles an hour. Backed by Boeing's unequalled multi-jet experience, the 720 is an extremely versatile jetliner able to operate profitably over short intercity and medium-range routes.

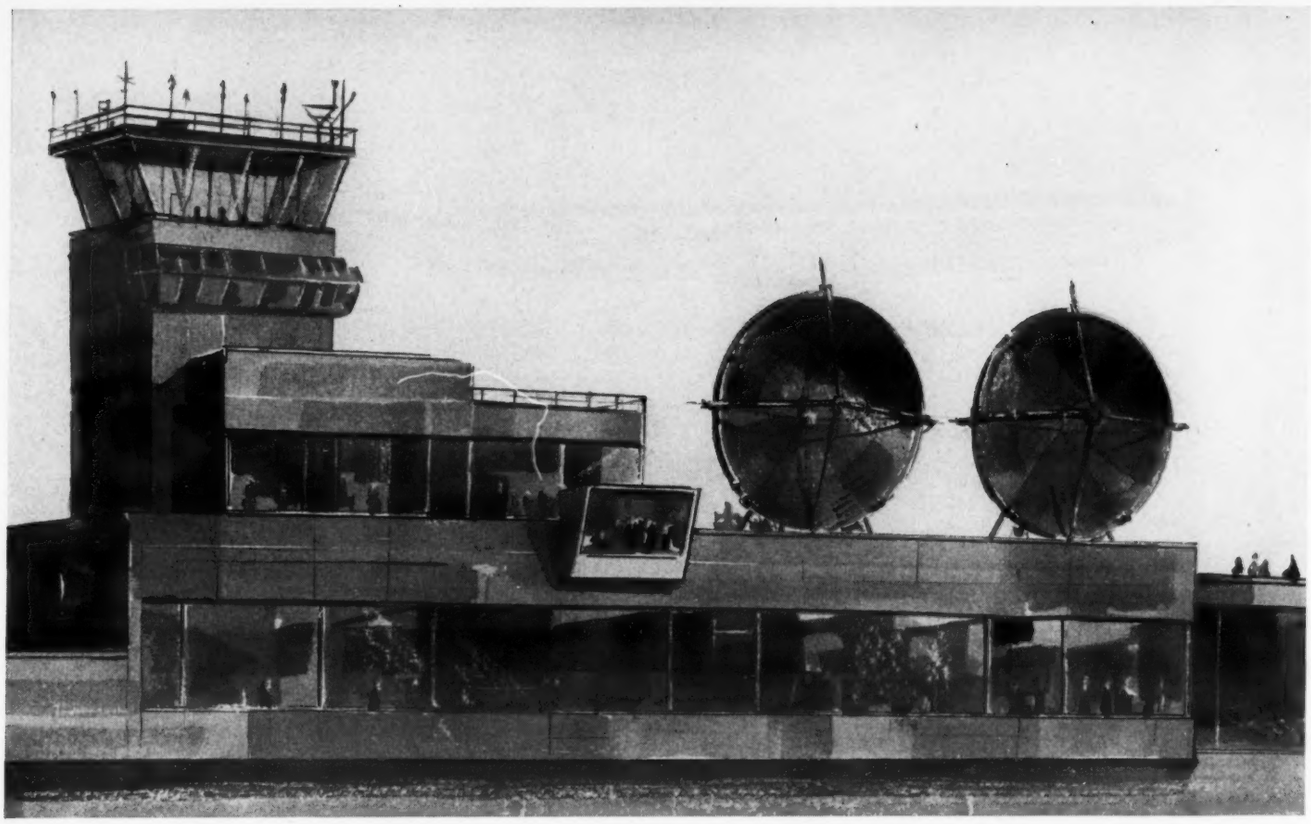
Boeing jetliners, now in scheduled service on United States and international routes, are demonstrating tremendous earning power, extremely high initial utilisation and unprecedented public acceptance.

These airlines have already ordered Boeing jets :

AIR FRANCE • AIR-INDIA
AMERICAN • B.O.A.C.
BRANIFF • CONTINENTAL
CUBANA • AER LINGUS
LUFTHANSA • PAN AMERICAN
QANTAS • SABENA
SOUTH AFRICAN • TWA
UNITED • VARIG • Also MATS

BOEING

Family of jet airliners



REMOTING RADAR DATA with

Canadian Westinghouse Microscatter

Now, Air Traffic Control from remote installations can be relayed *instantly and simultaneously* to points 100 to 200 miles distant!

Receiving signals from search radar, a remote MICROSCATTER unit can relay raw wideband video to airport control towers, command points or operation centres. Identical signals are received at all points at the same time. Data is transmitted *without* conversion into digital form. Communications are made with maximum speed and accuracy. MICROSCATTER also establishes long-distance links *between* control points.

Here are some of the proved-in-service features Westinghouse MICROSCATTER offers you:

- **BROAD BAND TRANSMISSION** of 5 mc. for sending high-quality raw video, azimuth, elevation, control and synchronization data.
- **FREQUENCY BAND** of 4400-5000 mc. will not interfere with radar operation.
- **HIGH RELIABILITY** of up to 99.99% in any weather with quadruple diversity.
- **SPAN** 100 to 200 MILES in a single hop.
- **LOW POWER**—Transmitter output 2 KW.
- **COMPACT EQUIPMENT** is ideal for remote installation. A complete repeater system can be mounted in a 40′ tractor trailer, or units can be delivered by helicopter.
- **LOW COSTS** of antennas (10′ to 28′ diameters), unattended operation, simple installation, low power consumption, easy maintenance all add up to substantial savings with MICROSCATTER radio.

MICROSCATTER APPLICATIONS

COMMERCIAL	MILITARY
Fixed Station —120 voice channels —television and sound	Wide Band —radar —data —120 telephone channels
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For complete information, write to Canadian Westinghouse Company Limited, Electronics Division, Hamilton, Canada.

YOU CAN BE SURE... IF IT'S **Westinghouse**

The Cargomaster can carry almost any piece of military equipment—assembled and ready for action.

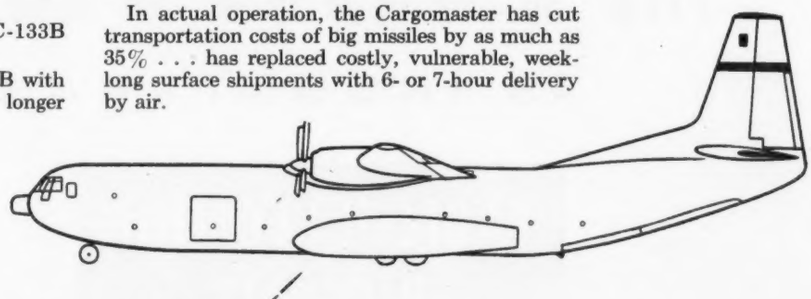
Douglas Cargomaster gives new mobility to NATO defenses

The giant Royal Air Force *Thor*, America's *Jupiter* and *Atlas*, England's *Black Knight* or any missile in the NATO arsenal can now be airlifted, fully assembled, to launching pads within range of any military target in the world.

The lifter—Douglas Aircraft's new C-133B Cargomaster.

Douglas designed the turbo-prop C-133B with the ability to carry greater payloads over longer distances than any other airplane. It can fly a 25-ton cargo *non-stop* from Ankara to Calcutta . . . from Sydney to Hong Kong . . . from Paris to Dakar at better than 320 miles per hour!

In actual operation, the Cargomaster has cut transportation costs of big missiles by as much as 35% . . . has replaced costly, vulnerable, week-long surface shipments with 6- or 7-hour delivery by air.



C-133B Cargomaster . . . can be loaded in as little as 10 minutes, utilizing a Douglas-developed conveyor and tie-down system. Maximum payload—90,000 pounds. Maximum speed—359 miles per hour!

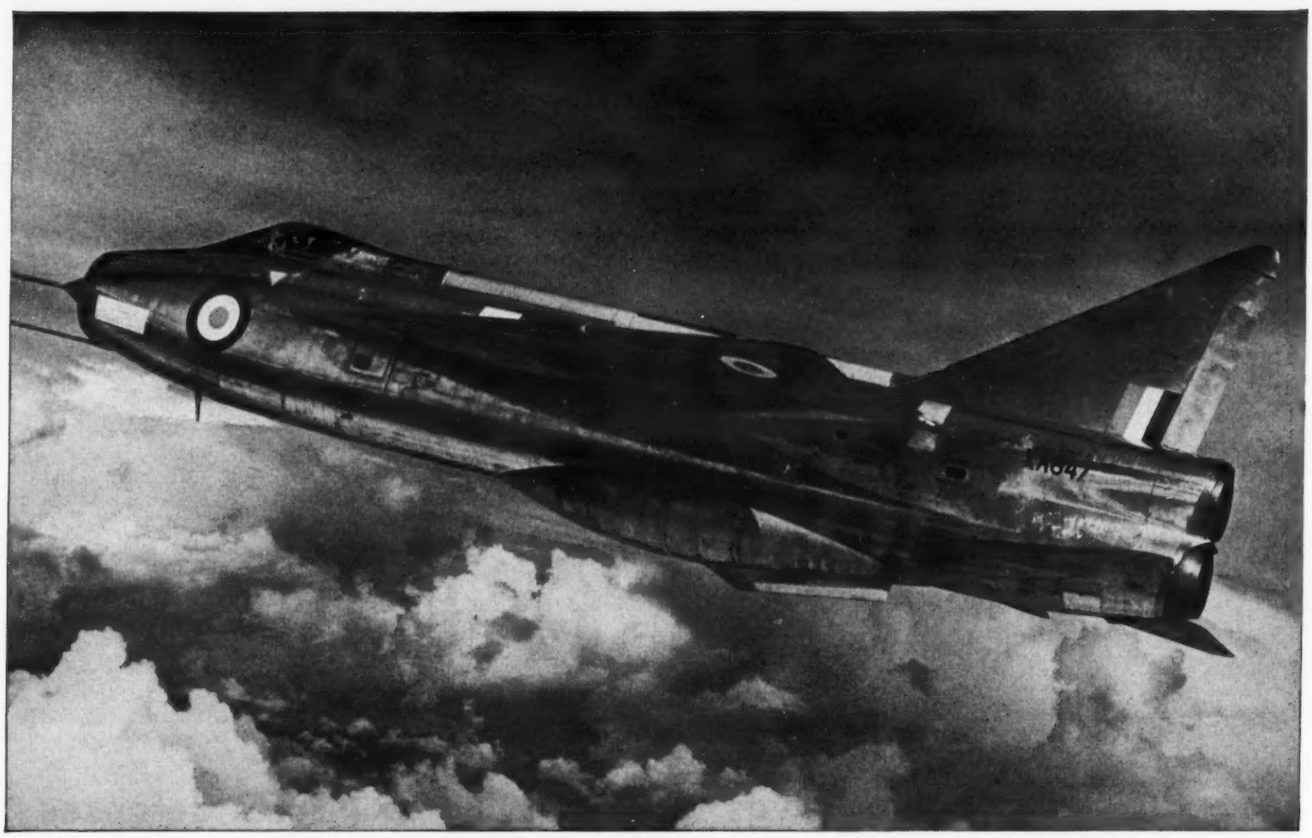
Depend on **DOUGLAS**

first in Aviation

1477

AS A PIECE OF APPLIED AERODYNAMICS...

Over the whole of its phenomenal speed range—far more than 10 to 1—from its moderate landing speed, through subsonic and transonic speeds, up to its very considerably supersonic maximum, the ENGLISH ELECTRIC LIGHTNING is inherently aerodynamically stable. Without any assistance from electronics it is at all speeds free from pitch-up.



...THE *LIGHTNING*

IS INCOMPARABLE

'ENGLISH ELECTRIC'
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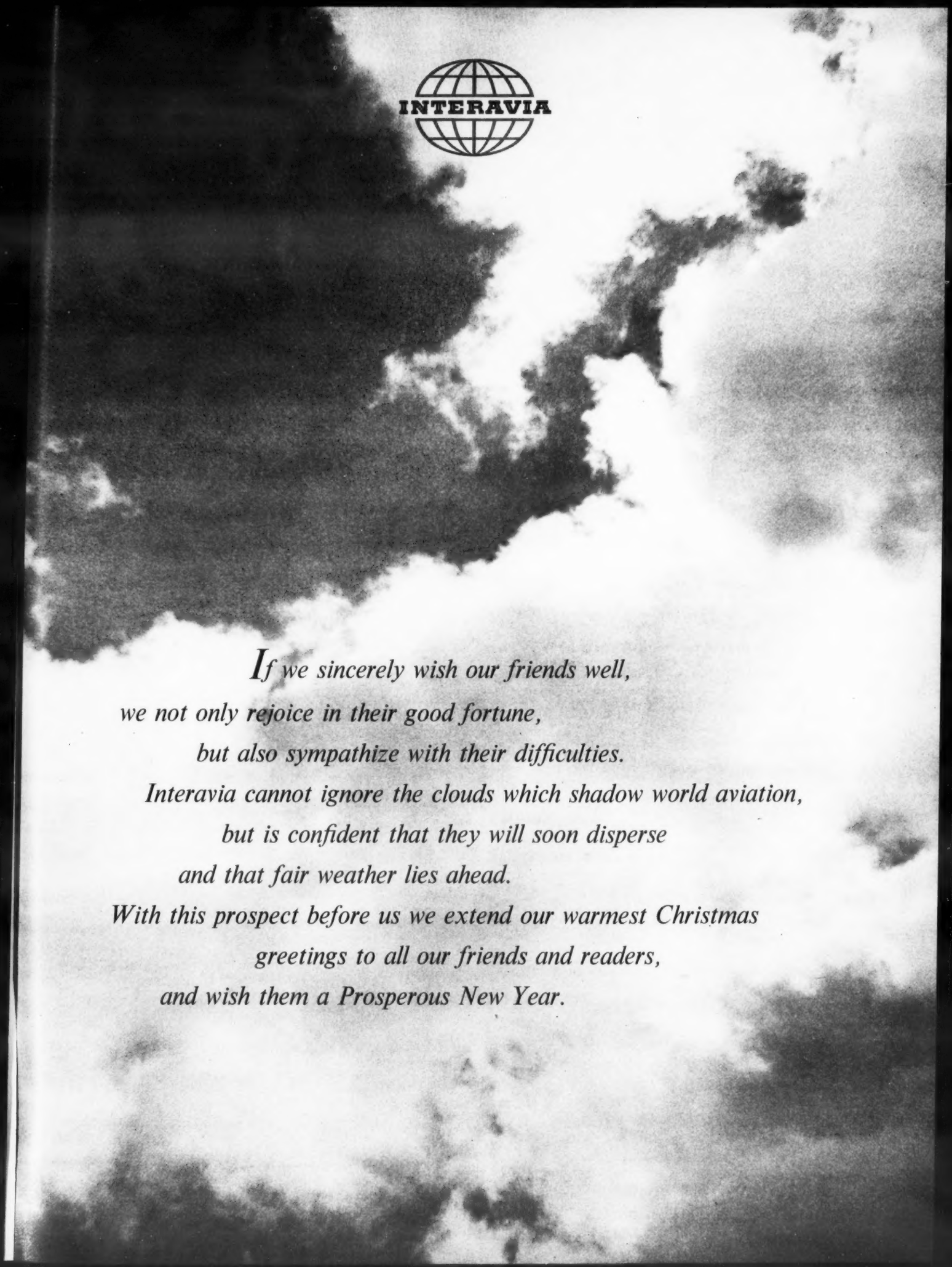


If we sincerely wish our friends well,
we not only rejoice in their good fortune,
but also sympathize with their difficulties.
Interavia cannot ignore the clouds which shadow world aviation,
but is confident that they will soon disperse
and that fair weather lies ahead.
With this prospect before us we extend our warmest Christmas
greetings to all our friends and readers,
and wish them a Prosperous New Year.

Fifty Years Old and Still Going Strong...

Helicopters Past and Present

When the topic of helicopters is discussed, the voices of certain economic experts take on a mournful note. Underlying their analyses and forecasts is the intimation that the helicopter will shortly be joining the dodo. The VTOL aircraft, they say, has sounded the helicopter's death knell.

It is an undeniable fact that people today are trying to make things difficult for the helicopter. But . . . is not the fixed-wing aircraft just a trifle uneasy under its sleek aluminium skin? Are not manned fighters and bombers themselves in fierce competition with rockets? As, however, the fixed-wing aircraft is not loosing its hold in the struggle, there is no reason why the rotary-wing aircraft with its many special applications should throw in the sponge before its time. In any case, helicopter designers can console themselves with the thought that, over thirty years ago, a well-known encyclopedia contained the statement that a helicopter could not be regarded as anything more than a toy. Subsequent development has proved beyond all doubt that this judgment was overhasty.

Turning back the clock

The helicopter entered the aviation scene not long after the fixed-wing aircraft. The Wright Brothers made their first "hop" in 1903, and only four years later, in 1907, the first helicopter proper, Louis Breguet's *Breguet-Richet,* left the ground—admittedly in captive flight.

The first free flights by helicopters as we know them today, however, were made in the Old World, again by the Frenchman Louis Breguet *(Breguet-Dorand–*1936) and by the German Focke (Focke Fw 61—1937), in the New World by the Russian-American pioneer Igor I. Sikorsky, who took off in his VS-300 in September 1939.

Whether one regards the helicopter as being twenty or fifty years old is a matter of personal preference, though incidentally, the first "flight-worthy model"—a spring-driven rotor invented by the Frenchmen Lounoy and Bienvenu—was successfully demonstrated to the Paris Academy as early as 1784. If, however, we take as a criterion not the ability to fly, but the conception of the design, then we must go back 450 years to find in the helicopter sketches of a certain Leonardo da Vinci the earliest origins of the rotary-wing aircraft.

It would be impossible to close this history-in-a-nutshell of the "pre-industrial" era of the helicopter without mentioning two men who, in the twenties, gave it the essential characteristics required for its development into the rotorcraft of today.

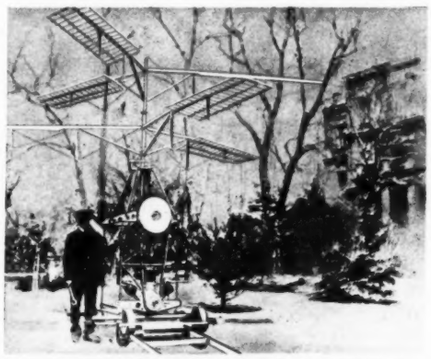
The Marquis Pateras de Pescara, an Argentinian who settled in Spain, built five helicopter models with coaxial contra-rotating rotors between 1919 and 1928. Imperfect as they were, and poor as was their performance, de Pescara's prototypes with their engines were the first complete helicopters to include all the controls as we know them today.

In 1923, after many unsuccessful attempts, another Spanish designer, Juan de la Cierva, brought out the autogiro, which Edison acclaimed as the answer to the needs of aviation and of people who "would like to fly, but are afraid to."

Industry adopts the helicopter

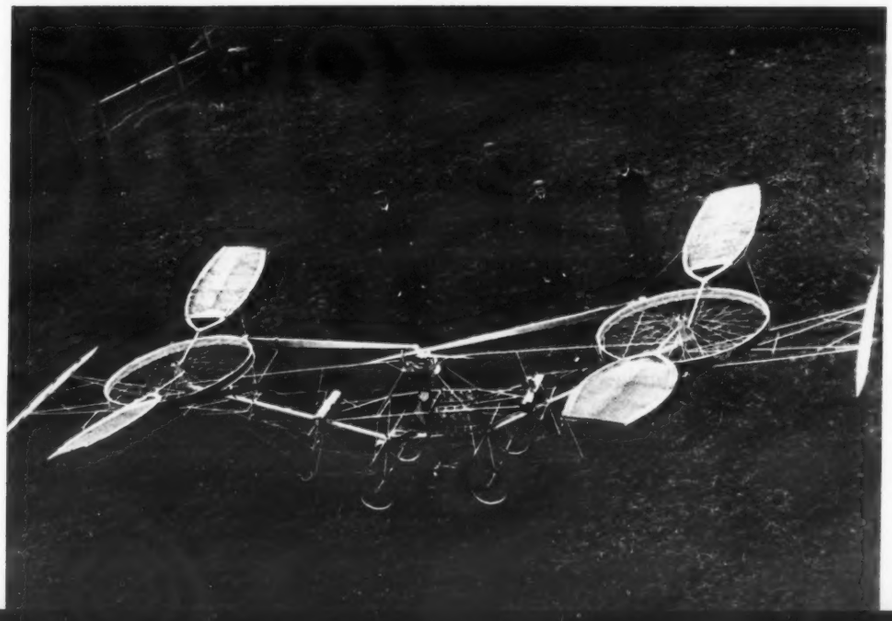
Following the 1939 flight of the Sikorsky VS-300, serious development of the helicopter began in the USA during World War II and led to quantity production in both America and Europe after the war.

To avoid anticipating the detailed descriptions given later in this issue, the present article is confined to a brief outline of the most important helicopter producers in the New World and the Old.



In spring, 1910, this helicopter, built by Igor I. Sikorsky, managed to leave the ground, but had serious difficulties with stability and control.

As early as 1907 a helicopter built by the French mechanic Paul Cornu made the "first ever" free flight; it had a tandem rotor, but no directional control.



USA

• *Sikorsky:* In January 1942 Vought-Sikorsky began flight-testing the first military helicopter prototype, the XR-4. A year later, *Sikorsky Aircraft* became a separate division of *United Aircraft Corporation,* concentrating on helicopter production, and subsequently brought out its well-known single-rotor military and civil transport helicopters: the four-seat S-51, the twelve-seat S-55, the fifteen-seat S-58, the S-56 heavy commercial helicopter etc.

• *Bell Aircraft Corporation,* too, which until America entered the war produced nothing but fighters, began to take an interest in helicopters in 1942. After the first experimental helicopter took off in 1943, development proceeded apace. Hundreds of Bell helicopters in all imaginable versions—from the 200 to 250-h.p. Bell 47 to the 1,900-h. p. HSL-1—were sold in both the USA and Europe. Italy and Japan acquired production licences for the Bell 47. Bell Aircraft

Corporation's helicopter output so increased in size and scope that a special section, the *Bell Helicopter Division,* was created to deal with it in early 1957.

• *Vertol:* Founded immediately after the war under the name Piasecki Helicopter Corporation, this concern was renamed the *Vertol Aircraft Corporation* on the withdrawal of its founder, Frank N. Piasecki, in March, 1956. Today in its Types 44 and 107 and in the *Chinook*, Vertol has wholeheartedly adopted the tandem rotor, whose stability is a main sales point in the firm's advertising. Frank N. Piasecki has, however, by no means retired from aircraft construction, but is developing light VTOL aircraft, such as "flying platforms," etc.

• *Hiller:* Many readers of *Interavia* Review will still remember the article "Young Mr. Hillercopter," which appeared in the March 1951 issue. Stanley Hiller, who built and tested his first rotorcraft at the age of 19, spared neither his money, his shins, nor the seat of his pants to achieve inherent stability in his small helicopters; *Hiller Aircraft Corporation,* which he founded in 1942, is today successfully marketing his designs in America and several Near Eastern States.

In addition to these "Big Four" a round dozen of smaller firms, including Cessna, Hughes, Kaman and McDonnell, are active in helicopter production.

Great Britain

• *Westland Aircraft* took its cue from the American helicopter industry at the end of the war and developed advanced versions of Sikorsky helicopters: The S-51 became the Westland *Widgeon;* the S-55 the *Whirlwind;* and the S-58 the *Wessex* (with a Napier *Gazelle* shaft turbine). Today the

In 1932, after building the first successful prototypes, the Spaniard Juan de la Cierva founded the Cierva Autogiro Co. Ltd. in Southampton, England. Pictured here is the Cierva C.30P Autogiro.

Westminster heavy helicopter is being flight-tested, and Westland recently took over the firm of Saunders-Roe, including its entire helicopter production.

• *Bristol Aircraft* produces mainly the single-rotor, five-seat 171 *Sycamore* helicopter and the 15 to 25-seat Type 192 for both military and civil applications.

• *Fairey:* A revolutionary design, the *Rotodyne,* cannot be ignored, although it operates as a helicopter only at take-off and landing and should technically be considered as a compound helicopter. For practical purposes it represents the first VTOL airliner.

France

Since the amalgamation of the State aircraft works SNCASE and SNCASO to form *Sud-Aviation,* France's helicopter production lies mainly in the hands of this undertaking. Sud-

September 1939: Igor I. Sikorsky at the controls of his VS-300 helicopter.

Aviation inherited the *Alouette* (Turboméca *Artouste* shaft turbine) from SNCASE and the *Djinn* (Turboméca *Palouste* turbo-compressor) from SNCASO. In addition, production of the SE.3200 *Frelon* (three Turboméca *Turmo III* shaft turbines) has now begun. In short, France has wholeheartedly pronounced in favour of the turbine-powered helicopter.

USSR

As a special article is devoted to Aeroflot's helicopters, it is enough to say that development in the East is by no means lagging behind activity in the West.

In 1937 the German Focke-Achgelis Fw 61 covered a distance of 144 miles.

In 1942 Sikorsky's first production helicopter, the R-4 (190 h.p. Warner engine) was originally delivered to the U.S. and British fighting forces as a training and multi-purpose aircraft.

In terms of hard cash . . .

Complete facts and figures are available only for the USA. The statistics of the U.S. Aerospace Industries Association show that helicopter sales remained at a very modest level until the Korean War. At that time the annual sales recorded by all American helicopter manufacturers amounted to only about $50 million. And since then? It would be foolish to shut one's eyes to figures. After reaching their peak three or four years ago, sales of helicopters have steadily declined. The AIA gives the following figures for the six major United States manufacturers.

Helicopter sales (in millions of dollars)

Year	*Military*	*Civil*
1954	202.6	104.8
1955	260.1	73.4
1956	283.6	53.4
1957	248.5	78.1
1958	243.1	51.9

And the order backlog has shrunk even more alarmingly:

Total order backlogs of the six leading American helicopter manufacturers (in millions of dollars)

Year	*Military*	*Civil*
1954	584.3	93.5
1955	469.0	71.1
1956	379.7	66.9
1957	251.5	29.5
1958	210.4	12.0

What of tomorrow?

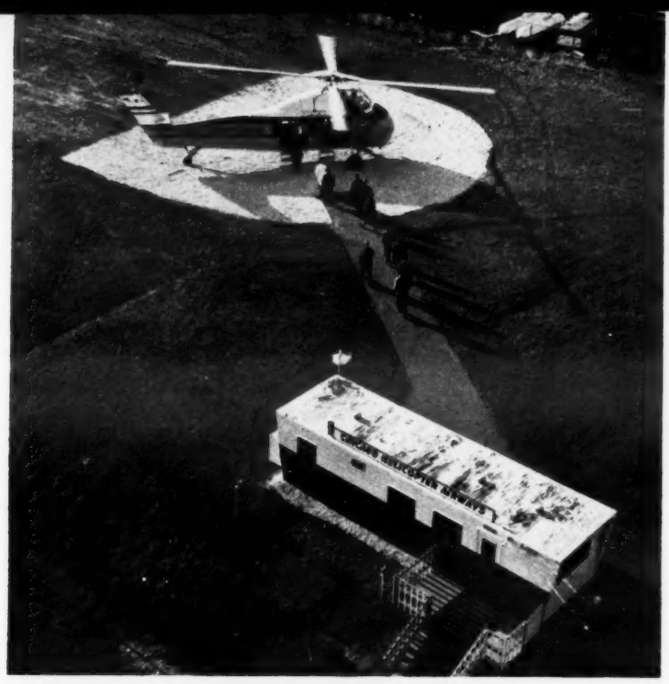
Certainly, the AIA figures give no cause for rejoicing. It would be rash, however, to read in them the final decline of the helicopter. Their true significance is that production of most operational types is coming to an end and that the line along which future types will develop has not yet become clear. What shape the situation will take after the appearance of the new generation of helicopters remains to be seen, but at present the helicopter is indisputably undergoing a thorough rejuvenation treatment:

- Operating costs are being lowered by the use of *shaft turbines.* For short stages of up to 100 miles the weight saved enables the payload to be increased by 40 percent with a corresponding reduction in cost per capacity passenger mile.
- Automatic systems are being developed and perfected to improve *stability.* In 1958 a system guaranteeing stabilization throughout a flight received FAA certification for commercial helicopters.
- *All-weather flight instrumentation* is being installed. In collaboration with the Port of New York Authority and the helicopter operator New York Airways the FAA initiated a programme for testing helicopter navigation systems in 1958. Such systems will naturally simplify air traffic control, enable flight plans to be maintained and permit optimum operation over heavily populated areas.
- Full use is being made of *aerodynamic "gimmicks,"* such as thin blades and Derschmidt rotors, to improve helicopter cruising speeds in commercial operations. Optimists speak of future cruising speeds of 200 knots and over.

To sum up: Although economically the helicopter has a bitter battle to win, its special characteristics and, in particular, its ability to hover, will render it indispensable for many tasks, today, tomorrow, and in the years to come.

All Aboard!...

Commercial Helicopter Services



"All aboard!" Chicago Helicopter Airways' Winnetka heliport, Illinois.

"All change!" Los Angeles Airways flies passengers from more than 20 towns direct to Los Angeles International Airport.

In agriculture and forestry, for ambulance services, for inspecting high-tension cables, in prospecting for ore and oil, in bridge- and dam-building . . . in all imaginable fields of air work the helicopter has, over the years, become an indispensable aid. Only in commercial air transport has it until quite recently suffered from a certain handicap. Today, with the appearance of the large 20- to 25-seat helicopter and the improved degree of safety achieved by the use of more than one engine, the old prejudices are vanishing. In both the New World and the Old specialized operators and commercial airlines are using helicopters for passengers, freight and mail—mainly on feeder lines from a city centre to an airport or from one city centre to another, but also—with success—on international routes. Below are notes on the best-known helicopter operators:

Los Angeles Airways

In 1947 was the first helicopter operator to run scheduled services in the Los Angeles area. Initially airmail and express deliveries, later (since November, 1954) scheduled passenger services. Connects over 20 towns with Los Angeles International Airport. Fleet consists of five Sikorsky S-55s and two Sikorsky S-51s. Five Sikorsky S-61s to be delivered in 1960 and 1961.

New York Airways

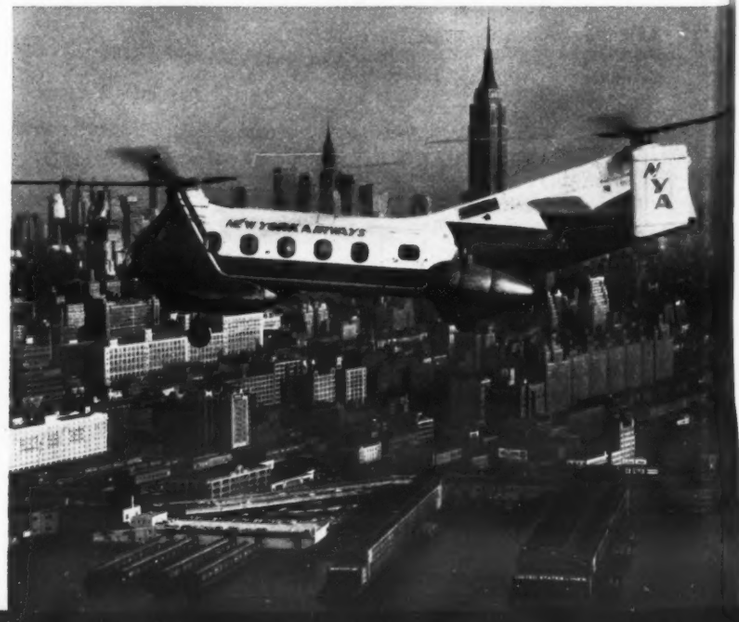
On October 15th, 1952, started scheduled letter and parcel post services between the three New York airports of Idlewild, La Guardia and Newark. Has been operating passenger services since July, 1953. Collaborates closely with North Atlantic operators. "Suburban services" to Teterboro, Stamford and White Plains. Since the end of 1956 has been using Manhattan heliport on the Hudson River, later landing-grounds on Wall Street and 42nd Street. Fleet consists of five Vertol 44Bs, two Bell 47Js. On order: five Fairey *Rotodynes*; option on five Vertol 107s.

Chicago Helicopter Airways

Emerged in 1956 out of Helicopter Air Service Inc., founded in 1949. Connects Chicago's two airports, O'Hare Field and Midway Airport, with the city centre

Helicopter replaces bus: Courriers Normands-Transcar Vertol 44.

From airport to city centre. New York Airways connects the airports of Idlewild, La Guardia and Newark with Manhattan.



As early as 1949 BEA operated regular night mail services between Peterborough and Norwich.

(Meigs Field). Flights to Gary, Indiana and Winnetka, Illinois. Over a hundred passenger flights daily with six Sikorsky S-58Cs and five Bell 47Gs. On order: three Sikorsky S-61s.

British European Airways

Created a special helicopter trial unit at the end of summer, 1947. First passenger service inaugurated 1950–51 on the Liverpool-Cardiff route with three Sikorsky S-51s. Further trial services London–Birmingham, London Airport–South Bank, Birmingham–Leicester–Nottingham. Has been using British helicopters since 1954: Bristol 171 *Sycamore*, Westland-Sikorsky WS-55. On order: six Fairey *Rotodynes* for planned services from London to Paris, Brussels and Amsterdam. Interested in Sikorsky S-61s and Bristol 192Cs.

Courriers Normands-Transcar

A successful attempt to replace the bus by the helicopter. During July and August, 1958, Société Générale des Transports Départementaux operated a helicopter service from Le Havre to Caen, with intermediate stops at Deauville, Cabourg, Honfleur and Ouistreham. Helicopter type: Vertol 44. Suspended for the time being, the service carried about 100 passengers daily with an average load factor of 52.5 percent.

Elivie

A subsidiary of Alitalia and Fiat. Services from Naples to Capri and Ischia for 3½ months during summer, 1959. Five flights daily to each island with four Bell 47J *Rangers*. 2,000 passengers and 15 tons of luggage in the first month of operation. Services are to be resumed in summer 1960.

Elipadana

Founded in Milan, July, 1959. On the programme: scheduled services from Milan to Turin, Genoa–San Remo, Lugano and Verona. First service opened on September 26th, 1959, on the route Milan (Rastelli landing-ground)—Malpensa Airport–Lugano (Switzerland). Three flights daily with Vertol 44Bs. Route proving flights with the Sikorsky S-62 on the Milan–Elba, Milan–Venice–Trieste and Milan–Turin routes.

One of Elivie's Bell 47Js over Marina Piccola, Capri.

...with Sabena

By A. V. J. Vernieuwe, Operations Manager, Sabena, Brussels

Anselme Vernieuwe, who has been Sabena Operations Manager since 1947, was born at Antwerp in 1916. During World War II he was a member of the Resistance, then joined the RAF as a pilot and flew a large number of combat and transport sorties; he was decorated with the Distinguished Flying Cross and the Belgian Croix de Guerre. After the war he joined Sabena and organized the company's first Atlantic services.

In 1950 he obtained Belgian helicopter pilot licence No. 1 and turned to the organization of Sabena's helicopter services — at first domestic mail services, and later the well-known international passenger network. On the first non-stop flights from Brussels to Paris in December 1953 and from Brussels to London in July 1954 he himself took the controls of the Sikorsky S-55 helicopter.

In 1954 he was second vice-chairman of the IATA Technical Committee, and in 1956-57 the Committee Chairman. Editors.

SABENA'S HELICOPTERS HAVE ALREADY CARRIED 250,000 PASSENGERS.

Although the flying machine with rotary wing is a very old dream of the aerodynamicists and aircraft designers, it developed much more slowly than the fixed-wing aircraft. In fact, the helicopter must be described as a recent development.

Nevertheless, despite the fact that it has lagged behind the fixed-wing aircraft, it has certainly not been entirely displaced by the latter. Of course, as regards pure speed, it can never compete with the aeroplane, but it has its own qualities which give it a special place in the field of aviation. For example, its basic design confers on it a degree of freedom in flight manœuvres which will always be denied to the conventional aeroplane. The ability to take off vertically, combined with hovering capacity, put the helicopter in a class by itself and have enabled a multitude of new applications to be devised.

Imagination has had full play and soon gave rise to a large number of applications whose main principle can be defined in a few words: "when a given point is inaccessible by any other means of transport, think of the helicopter." Thus the rotorcraft has already rendered invaluable services in rescue operations, survey work and even public works. For example, on one occasion a Sabena helicopter was used to carry a high tension electric cable across an electrified railway line on which traffic had to be maintained at all times.

Basically, of course, city centre to city centre air transport is only one of the many tasks which can be undertaken successfully by the helicopter. But this one application would justify its existence and consequently the efforts made, in particular by Sabena, to extract full advantage from its potential.

It would perhaps be well to outline here the reasons which led to the Belgian airline's particular interest in the helicopter. The first is of a geographical nature; in fact the position of Belgium and of its capital Brussels was the determining factor. Situated at the centre of one of the most

Three Sikorsky S-58s at the Allée Verte Heliport, Brussels.

highly developed areas in Europe or even in the world, from both the commercial and the industrial points of view, Brussels was the ideal point of departure for the creation of a network of high-speed, short-range transport. The region within a radius of some 200 miles of the Belgian capital includes economic areas of immense importance, such as the Ruhr in West Germany, the Grand Duchy of Luxembourg, northern France, the Belgian mining and industrial belts, Holland and southeast England. Between London and Frankfurt, Amsterdam and Paris cities of first or second importance are concentrated in close proximity. The number of large international airports cannot be increased indefinitely, which means that many important localities are handicapped by their distance from these airports. The services of the helicopter, which needs very little space for take-off and landing and can pick up and set down passengers in the city centre, become indispensable to these cities in a world where speed of travel is more important every day.

The second reason which led Belgium to adopt the helicopter was a commercial one and a necessary corollary to the first. The helicopter has made it possible to create a transport network to feed the long-distance aircraft, whose departures and arrivals could thus be concentrated at a single point, Brussels National Airport.

However obvious were the advantages of such an undertaking, it was naturally not possible to create this network in a single move. We had to advance by stages, take advantage of circumstances and of the machines commercially available. We had, too, to accumulate experience patiently, build up a reserve of pilots, in short to invent a new means of transport.

The first stage began in 1950. On August 21st of that year Sabena inaugurated the first helicopter mail service on the European continent. The machines used were small Bell 47Ds fitted with special boxes to carry the mail. The landing fields used had been reconnoitred in advance, but in most cases were no more than a well-mown field or a football pitch. The helicopters landed briefly —staying not more than three minutes—and waiting Post Office officials collected the mail or deposited it in the boxes. Nine Belgian cities were served regularly: Brussels, Libramont, Liège, Tongres, Hasselt, Beeringen, Turnhout, Herenthals and Antwerp. Later, when the Bells had been replaced with Sikorsky S-55s, a tenth city, Maastricht in Holland, was added to the mail circuit. The service was maintained until September 15th, 1959, by which date the total quantity of mail carried had amounted to 348 tons.

In February 1953 tragic circumstances arose which proved not only the helicopter's talents but also the skill already acquired by the first Belgian helicopter pilots. A tidal wave ravaged the coasts of Holland. Before the storm had subsided Sabena's three helicopter pilots had left Brussels National Airport aboard their Bells to bring aid to the stricken Dutch. In a few harassing days they were able to carry out a multitude of rescue operations.

*

The first phase closed with this exploit. Soon afterwards Sabena took delivery of the eight-seat Sikorsky S-55s, its first helicopters suitable for the regular transport of passengers. On August 1st, 1953, the Mayor of Brussels, attended by all the city notables, ceremonially opened the Allée Verte heliport, in the heart of the capital.

On September 1st, 1953 the next big step was taken. Sabena opened the first international helicopter services, and S-55s took off from Brussels for Lille, Rotterdam and Maastricht. Everywhere response was enthusiastic. The helicopter's popularity could only be compared with the public's attitude to the flying meetings of the beginning of the century.

The first helicopter network soon expanded: Cologne and Bonn were added on October 5th, 1953. Then in 1955 a new service was opened between Brussels and Eindhoven (Holland), and this was extended to Duisburg in June of the same year and to Dortmund in May 1956.

Meanwhile experimental operations were being carried out elsewhere. A service between Brussels and Paris was carried out on December 20th, 1953, and on July 7th, 1954, 45 years after Blériot, the helicopter crossed the Channel and landed a few hundred yards from the Houses of Parliament, in the heart of London.

*

The third phase of helicopter operations began with a record. On October 4th, 1956 the first two Sikorsky S-58s delivered to Sabena beat the speed record between Paris and Brussels by covering the distance between the two city centres in 1 hour 16 minutes.

These new machines, of which Sabena was soon to have eight, had a higher speed than their predecessors and seating capacity for 12 passengers. They were soon to enable the company to open the regular Brussels–Paris service, on March 3rd, 1957. The service was inaugurated in spectacular fashion by eight helicopters flying in formation, and marked the fulfilment of one of Sabena's dearest ambitions as regards helicopters.

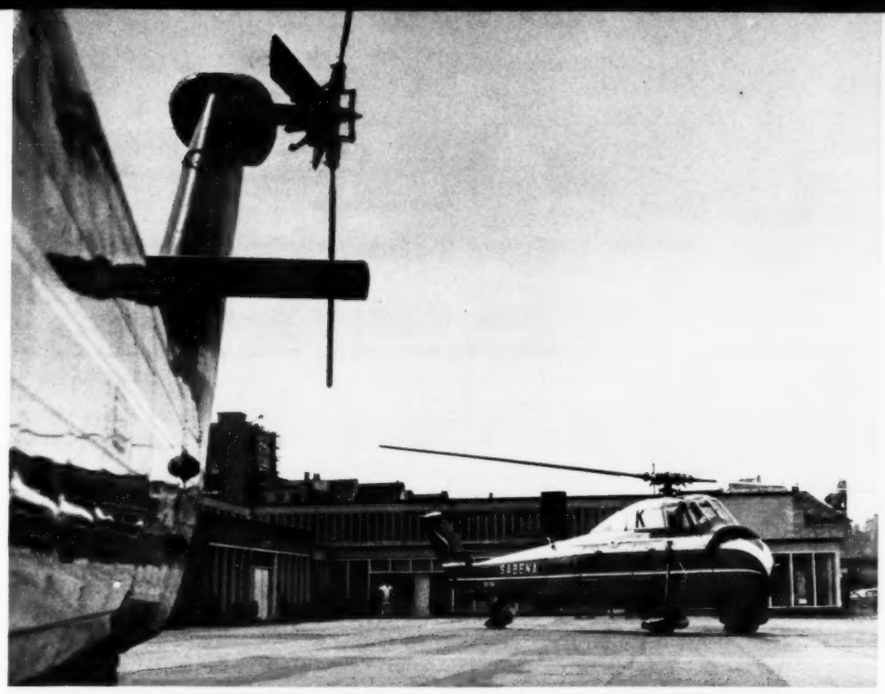
*

What will be the next stage? Without doubt the principal stage that can be envisaged at the moment is a regular service from Brussels to London. But the question of regularity imposes certain requirements which, in the case of services across the sea, cannot be met by the machines available at present. Before this project can be put into effect, we must have multi-engine helicopters.

These remarks on the future of the helicopter network bring me to the question of the selection of machines and their future. I am still convinced that the rotorcraft will ultimately take over all short-stage routes covering distances of under 250 miles. Yet I also think that the helicopter will give way to the "combination" aircraft. What makes helicopter operation so costly is the fact that the rotor has to support the full weight of the machine and at the same time supply power for flight. Even small stub wings provide sufficient lift to remove some of the load from the rotor disc and thus to postpone blade-tip stalling. The saving in power thus achieved would result not only in increased cruising speed but also in reduced costs.

The multi-turbine design I should like to see would enable speed and comfort to be increased and give a safe power margin in the event of engine failure. With a multi-engine machine it would be possible to fly on instruments and thus obtain more rational utilization of the equipment, which at present cannot fly at night or in poor visibility. If I may be permitted to dream—and in aviation today's dreams have so often been tomorrow's realities—I would say that I foresee a convertible aircraft with seating for sixty passengers, a cruising speed of 160 knots and a normal range of 250 miles. Its power units would be gas turbines, which would give the best power-weight ratio, eliminate vibrations and reduce noise level to a minimum.

And while I am making "demands," I would say that the "parking" problem, which will inevi-



Terminal building at the Allée Verte Heliport

tably grow more serious as traffic expands, should be considered in the design of future machines. It will probably be necessary to make use of the lakes, rivers or canals which are to be found in most cities. The aircraft will load and unload their passengers on a floating platform and will "park" on the water. The ideal machine will therefore be an amphibian.

*

Sabena's helicopter experience can be summarized in figures as follows: twenty-two fully trained pilots have made nearly 35,000 flights; one of them has more than 5,000 hours flying time to his credit, another three over 4,000, four over 3,000 hours, seven over 2,000, and four over 1,000. The chief pilot himself has logged 6,000 flying hours.

A total of 3,703,000 miles has been flown, with a regularity of more than 85 percent. The number of passengers carried has already exceeded 250,000, which gives the helicopters an advance of twelve years over the company's fixed-wing aircraft: it took Sabena 21 years from its foundation in 1923 to reach its first quarter million passengers.

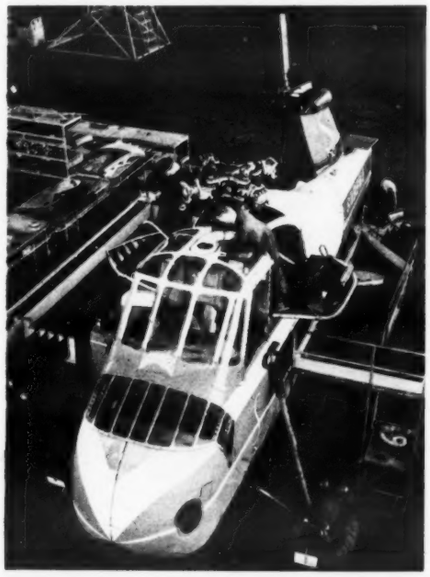
The number of international passengers carried on the Belgian helicopter services has grown from year to year and gives a clear idea of the economic value of this traffic: in 1953 passengers totalled 3,516, in 1954 the number rose to 12,656, in 1955 to 16,063, in 1956 it dropped slightly to 15,751, then rose sharply in 1957 to 36,929 and in 1958 to 46,563.

The principle that helicopters should serve as "feeders" to conventional aircraft is obviously of great importance in the organization of these services. "Transit" passengers—i.e., those transferring from helicopter to aeroplane or vice versa on the same journey—have also increased in numbers: in 1953 there were 575, in 1954 the figure rose to 3,541, in 1955 to 5,592, in 1956 to 7,763, in 1957 to 15,141 and in 1958 to 17,982. This category of passengers forms 38.4 percent of total helicopter customers.

A comparison between sales of helicopter services and the company's total sales will set this side of the business in its proper perspective. Helicopter sales in 1958 were 96,700,000 francs, or 2.6 percent of the total sales (3,700,000,000 francs).

Is it possible to define a "philosophy" of helicopter passenger operations? The essential principle of such a philosophy would undoubtedly be economy. Economy of time for the traveller, who at last has air transport within his reach in the heart of the city, economy of space as regards the size of a heliport, economy of administrative work, at any rate at Sabena where aircraft papers have been reduced to the strict minimum.

The same considerations of economy have guided our technicians in preparing overhaul programmes. In view of the operational characteristics of the helicopter, which flies only in daytime and whose utilization must therefore be reduced in winter, there are two different seasons in the helicopter overhaul year: in summer the machines do not undergo major overhauls, and current maintenance is carried out at night, so as to achieve the greatest possible number of flying hours. Seven machines are flying on any given day, while one is used as both stand-by and training machine. In winter six machines only operate regular services, one is undergoing overhaul, and the eighth serves as stand-by.



Preparing to install D/F equipment in a Sikorsky S-58 helicopter.

A Sabena S-58 helicopter undergoing a full overhaul.

The maintenance programme is very comprehensive, and a "quick change" system enables whole assemblies, such as the engine and its accessories, the main transmission and the rear transmission, to be replaced bodily in the minimum of time.

Both the helicopter and the vertical take-off aircraft which will succeed it will be carried along by the breathtaking advance of aviation. Being essentially suitable for a certain category of air transport, they will ultimately replace the conventional aeroplane over the short-stage routes which are their forte.

Helicopters in Soviet Civil Aviation

By V. Nazarov, Departmental Head,
Central Administration
of the Civil Air Fleet, Moscow

Laying the Serpukhov-Leningrad gas pipeline. A Yakovlev Yak-24 heavy helicopter transports reinforced concrete blocks weighing three tons.

Aeroflot has been using helicopters since 1954. In recent years improved types have been added to its fleet and the role of rotary-wing aircraft considerably extended to include passenger and freight transport, aerial prospecting, ambulance services, pest control in orchards and vineyards, fishery and game protection, and the fighting of forest fires.

The following are the main types in service with Aeroflot: Mi-4, Mi-1 and Ka-15; the Yak-24 (two piston engines) and Mi-6 (two shaft turbines) heavy helicopters have also proved highly efficient. The choice of type naturally depends on the nature of the work and on operating conditions.

The Mi-4 helicopter, designed by M. L. Mil, has one main rotor and a three-blade anti-torque tail rotor. It is powered by a 1,700-h.p. ASh-28 V engine. Its normal all-up weight is 15,700 lb; the diameter of the main rotor is 69 ft, that of the tail rotor 11.8 ft; speed in level flight is 87 m.p.h. This type is designed mainly for the transport of passengers and freight. In the former role it will accommodate 10 passengers, in the latter it will take a total 2,650 lb of freight.

The Mi-4 is a helicopter of proven performance, operating as satisfactorily in the frozen north of the Soviet Union as in the high temperatures in the south of the country. The passenger version, whose comfortable cabin contains ten upholstered seats, is particularly appreciated by holidaymakers on the shores of the Black Sea, where it is used for connections between airports and larger resorts. Passengers arriving at an airport change to helicopters which are waiting to carry them to their destinations. The Mi-4 is also indispensable for carrying fire-fighting squads and equipment to the scenes of forest fires.

The Mi-1 helicopter, also designed by M. L. Mil, has a 430-h.p. AI-26V piston engine. Its normal all-up weight is 5,290 lb; the three-blade main rotor has a diameter of 47.6 ft, the tail rotor a diameter of 8.2 ft; speed in level flight is 87 m.p.h. The Mi-1 is used for geophysical surveys in mountainous terrain, for ambulance work, in the forestry service, for fishery protection and for agricultural operations such as pest control and crop-spraying. It can transport three passengers

The Kamov Ka-15 helicopter is used to protect vines.

The Mi-6 heavy helicopter (two Soloviev TB-2BM shaft turbines, each of 4,700 h.p.) carried a 12-ton payload to a height of 8,000 ft at the end of 1956.

or 660 lb of freight. Stretcher cases are transported in pods attached to each side of the fuselage.

The Ka-15 helicopter, designed by N. I. Kamov, with two coaxial contra-rotating rotors and a 255 h.p. AI-14V piston engine, is small in size and can therefore, if necessary, take off from the deck of a fishing vessel. It is easily manoeuvrable and more economical to run than other helicopters of this class. Its tasks include postal and air freight deliveries to outlying communities, ambulance service and pest control.

This year Ka-18 helicopters began passenger, freight and rescue operations. The Ka-18, which is a development of the Ka-15 and uses the same powerplant, can also be fitted with pest control equipment. It can carry three passengers or a stretcher case with doctor. Its range is 250 miles, its cruising speed 68 m.p.h. and ceiling 10,000 ft.

Helicopters have the following advantages for the control of pests and plant diseases:

- A helicopter needs no airfield from which to operate, but only an area measuring 100×50 ft with freedom of access. Such a base can nearly always be found in the immediate vicinity of the area to be treated, thus considerably reducing the time taken to reach the site.
- The chemical spray is blown vertically groundwards by the rotor downwash, rebounding onto the underside of the plant leaves, so that spraying is far more effective than with fixed-wing aircraft.
- The helicopter's ability to hover enables it to be used in restricted spaces, mountains, market gardens, vineyards and forests.

Ka-15 and Mi-1 helicopters are fitted with removable equipment for agricultural purposes.

The Crimean resort service. The Mil Mi-4 at Simferopol airport.

The Mi-1 in the service of agriculture.

A dwarf and a giant: The Mil Mi-1 (foreground) and Mi-6 helicopters.

The main data for these helicopters and their performance in agricultural operations are given below:

	Mi-1	*Ka-15*
Chemical tank capacity	115 Imp.gall.	75 Imp.gall.
Maximum chemical payload	660 lb	440 lb
Swath width for spraying	230 ft	215 ft
Delivery rate for liquid chemicals	120 g.p.m.	66 g.p.m.
Swath width for DDT dusting from a height of 16 ft over level ground	390–425 ft	230–330 ft
Swath width on slopes with a gradient of 35–40°	525 ft	525 ft
DDT maximum delivery rate	450 lb/min	220 lb/min
Recommended flying speed over area to be treated	15–18 m.p.h.	15–18 m.p.h.

An aerosol generator is fitted to the Ka-15 for dusting and spraying. As every helicopter has both spraying and dusting equipment, it takes only half an hour to switch from one mode of operation to the other. The spraying and dusting equipment can be operated with the helicopter flying at any speed or hovering. For this purpose it is connected to the engine via a gear system, the air being pumped into the nozzles either through the engine fan (as in the Mi-1) or through a special blower (as in the Ka-15).

Experience during the first two years of operation has shown that for the treatment of orchards and vineyards the helicopter can give far better results than either ground equipment or fixed-wing aircraft, and it is planned to extend this service on a large scale.

Catalogue of Rotary-Wing Aircraft

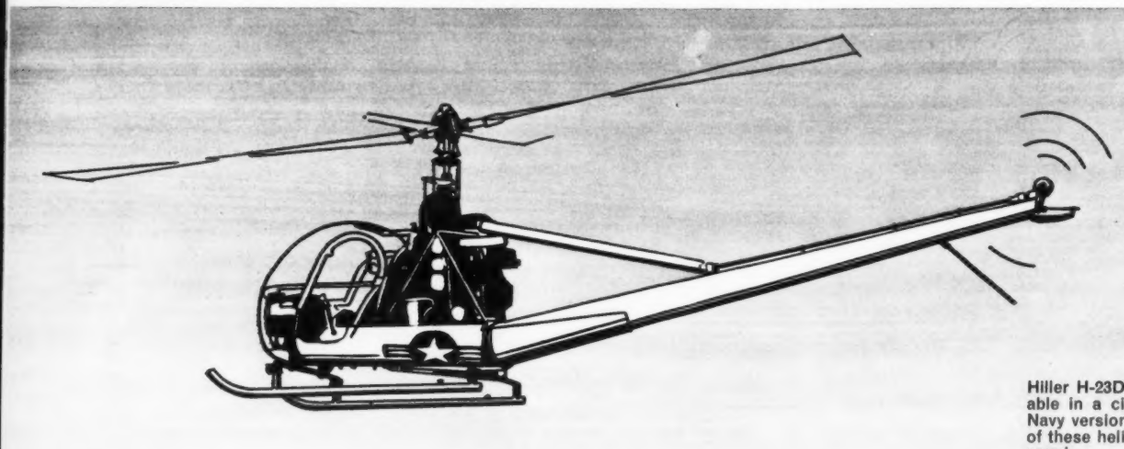
The accompanying table is designed to give the reader an idea of the large number of civil and military helicopters available on the market. Although this is by no means intended to be a complete catalogue, the fifty types listed show the wide range of specifications for aircraft in this category: from single-seat ultra-light helicopters with all-up weights between four hundred and seven hundred pounds, to medium-weight rotary-wing aircraft with take-off weights of over five tons. The real "heavyweights" are omitted from the table, as a separate article is devoted to them in this issue. Special articles also deal with the importance of the rotary-wing aircraft in civil flying.

Finally it should be stressed that during recent months there has hardly been a single new design for a piston-engined medium-weight or heavy helicopter. The change-over to turbine operation, along the same lines as that being effected in fixed-wing aircraft, is unmistakable.

Small Piston-Engined Helicopters — Gross Weights Up To One Ton

Type designation	Saunders-Roe Skeeter AOP.12	Omnipol HC.2 Heli-Baby[1]	Bölkow Bö 103[2]	CTA Beija Flor	Agusta 103/103B[3]	Aerotécnica AC-12	Bensen B-7M Gyro-Copter[4]	Brantly B-2 U.S. Army: YHO-3BR	Convertawings Quadrotor Model A
COUNTRY	GREAT BRITAIN	CZECHO-SLOVAKIA	German Federal Republic	BRAZIL	ITALY	SPAIN	USA	USA	USA
Engines (no. and type) Max. take-off rating	1×de Havilland Gipsy Major 215 1×215 h.p.	1×Praga DH 1×83 h.p.	1×Agusta 1×85 h.p.	1×Continental 1×225 h.p.	1×M.V. GA-70/70V 1×80/85 h.p.	1xLycoming O-320 (also O-360) 1×150 h.p.	1×Nelson H-39A 1×42 h.p.	1×Lycoming VO-360-A1A 1×180 h.p.	2×Continental C.90 2×90 h.p.
Max. take-off weight Max. payload (P) or max. useful load (U) Max. no. of seats	~2,200 lb — 574 lb (U) 2	1,280 lb — — 2	~880 lb — — 1	2,090 lb — — 2	970/1,060 lb — — 1 or 2	1,590/1,650 lb — 530+lb (U) 2	450 lb — — 1	1,600 lb 460 lb (P) — 2	2,200 lb — — —

1 A six-seat version, the HC-3, is being developed. 2 With single-blade main and tail rotors. 3 The 103 is a single-seat version, the 103B has two seats. 4 Autogyro; also exists in B-8M version with 72-h.p. McCulloch engine.



Hiller H-23D *Raven* three-seat helicopter, also available in a civil version designated UH-12E. A U.S. Navy version is known as the HTE. Several hundred of these helicopters have already been built and delivered.

Medium-Sized Piston-Engined Helicopters—Gross Weights Up To Three Tons

Type designation	Bristol 171 Sycamore	Westland Widgeon	Borgward-Focke (BFK.1) Kolibri 1	Aer Lualdi L.59	Agusta-Bell Model 102	Motoimport (PZL) SM-1[5]	Motoimport (PZL) BZ.4 Zuk	Kamov Ka-15
COUNTRY	GREAT BRITAIN	GREAT BRITAIN	German Federal Republic	ITALY	ITALY	POLAND	POLAND	USSR
Engines (no. and type) Max. take-off rating	1×Alvis Leonides Mk.173 1×500/525 h.p.	1×Alvis Leonides 521/2 1×515 h.p.	1×Lycoming VO-435-A1B 1×260 h.p.	1×Continental IO-470-D 1×260 h.p.	1×Pratt & Whitney R-1340 1×600 h.p.	1×Ivchenko AI-26 V 1×575 h.p.	1×Narkiewicz WN-4 1×320 h.p.	1×Ivchenko AI-14 V 1×255 h.p.
Max. take-off weight Max. payload (P) or max. useful load (U) Max. no. of seats	5,400/5,600 lb — 1,270 lb (U) 4 to 5	5,900 lb 635 lb (P) — 5	2,490 lb — — 3	2,425/2,535 lb — 1,040/1,150 lb (U) 4	6,220 lb — ~2,120 lb (U) up to max. 10	5,390 lb — 1,200 lb (U) 3 to 4	3,310 lb — 990 lb (U) 4	— — — 2

6 The Soviet Mi-1 built under licence; SM-1S (ambulance service—two stretcher cases and one attendant) and SM-1Z versions, and a four-seat derivative, the SM-2.

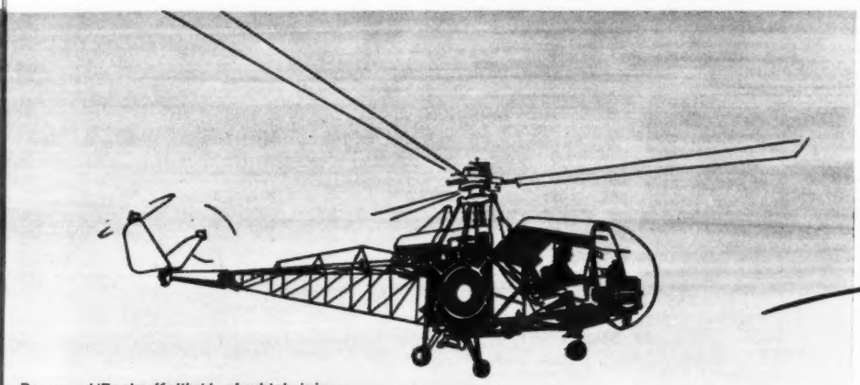
The four-seat Bell 47J *Ranger* is in quantity production and is being delivered not only to civil customers but also—in large numbers—to the U.S. Navy (designations HUL-1 and HTL-7) and the USAF (designation H-13J).

GREAT BRITAIN: Saunders-Roe *Skeeter 6*.

Fairchild Umbaugh U.18	Goodyear GA-400R-3 Gizmo	Gyrodyne YRON-1 Rotorcycle	Hiller XROE-1	Hughes 269A U.S. Army: YHC-2HU	Hélicop-Air L.50/L.51 Girhel[5]
USA	USA	USA	USA	USA	FRANCE
1×Lycoming O-360 1×180 h.p.	1×Johnson 35 1×38 h.p.	1×Porsche GP-702 1×72 h.p.	1×Nelson 63 1×45 h.p.	1×Lycoming O-360-C2B 1×180 h.p.	1×Continental or 1×Lycoming 1×90 h.p. or 1×150 h.p.
—	490 lb	820/900 lb	~500 lb	1,550 lb	1,380/1,650 lb
—	~200 lb (U)	—	~200 lb (P)	—	—
—	—	—	—	—	—
2	1	1	1	2	2

5 Autogyro.

GREAT BRITAIN: Bristol 171 *Sycamore*.



Borgward/Focke *Kolibri I*, of which initially a small batch is to be built. A first pre-production *Kolibri I* is already undergoing flight tests, a second is at the final stage of assembly.

POLAND: The medium-sized SM-1Z helicopter, built in Poland under Soviet licence, powered by a 575-h.p. Ivchenko AI-26V piston engine.

Kamov Ka-18	Mikhail L.Mi 1 Mi-1[7]	Bell 47G-2 Trooper U.S. Army: H-13H Sioux U.S. Navy: HTL-6	Bell 47J Ranger USAF: H-13J U.S. Navy: HUL-1/HTL-7	Cessna CH-1C U.S. Army: YH-41 Seneca	Doman LZ-5-2 (YH-31)	Hiller UH-12[8] U.S. Army: H-23 Raven U.S. Navy: HTE	Omega BS-12D	Vertol 18[9] U.S. Army: H-25A Army Mule U.S. Navy: HUP Retriever
USSR	USSR	USA	USA	USA	USA	USA	USA	USA
1×Ivchenko AI-14R 1×255 h.p.	1×Ivchenko AI-26W 1×575 h.p.	1×Lycoming VO-435 1×260 h.p. (down-rated to 200 h.p.)	1×Lycoming VO-435 1×260 h.p. (down-rated to 240 h.p.)	1×Continental FSO-526A 1×270 h.p.	1×Lycoming SO-530-A1B 1×400 h.p.	1×Lycoming VO-435-A1C 1×250 h.p.	2×Lycoming G-540-F1B5 2×260 h.p.	1×Continental R-975-46 1×550 h.p.
2,890 lb	4,960 lb	2,450 lb	2,800/2,850 lb	3,100 lb	5,200 lb	2,700 lb	4,750 lb	5,750/6,100 lb
440/660 lb (P)	—	—	—	—	—	—	—	—
—	—	~880 lb (U)	1,185/1,205 lb (U)	1,040 lb (U)	1,950 lb (U)	~1,000 lb	~1,450 lb (U)	1,700+lb (U)
4	3 to 4	3	4	4	8	3	5	up to 6

7 Also available in the Mi-S version, very similar to the Mi-1, but with four-blade main rotor and designed for a gross weight of 5,170 lb. 8 The UH-12E is the civil version of the H-23D, but with a 305-h.p. engine; there is also the H-23D-1, powered like the civil UH-12E by a 305-h.p. Lycoming engine. 9 Versions: HUP-1 powered by a 525-h.p. Continental R-975-34 engine, the HUP-2 powered by a 550-h.p. Continental R-975-46 engine, the HUP-3 and HUP-4, each powered by an 800-h.p. Wright R-1300 engine; production of these helicopters has now ceased.

Medium-Sized Piston-Engined Helicopters—Gross Weights over Three Tons

Type designation	Westland Whirlwind[10]	Bell Model 61 U.S. Navy: HSL-1	Sikorsky S-53[11] U.S. Navy: HSS-1 U.S. Army: H-34 Choctaw Marine Corps: HUS-1	Sikorsky S-55 USAF and U.S. Army: H-19 U.S. Navy & Coast Guard: HO4S; Marine Corps: HRS	Vertol Model 43[12] USAF and U.S. Army: H-21 Shawnee
COUNTRY	GREAT BRITAIN	USA	USA	USA	USA
Engines (no. and type)	1×Pratt & Whitney R-1340-40 or 1×Alvis Leonides Major 755/4	1×Pratt & Whitney R-2800-50	1×Wright R-1820-84 Cyclone	1×Pratt & Whitney R-1340 or 1×Wright R-1300-3	1×Wright R-1820-103
Max. take-off rating	1×600 h.p. or 750 h.p.	1×1,900 h.p.	1×1,525 h.p.	1×600 h.p. or 1×700/800 h.p.	1×1,150 h.p. (down-rated performance)
Max. take-off weight	7,500/7,800 lb	26,500 lb	up to max. 13,600 lb	7,200/~7,900 lb	11,500 lb
Max. payload (P) or max. useful load (U)	— ~2,200/2,500 lb (U)	— —	— up to 5,200+lb (U)	— 2,250 lb (U)	— ~3,550 lb (U)
Max. no. of seats	10 to 12	4 (Large quantity of anti-submarine equipment)	up to 20	12	up to 16

10 Available in many civil and military versions; also in versions powered by a 700/800-h.p. Wright R-1300 engine; a version powered by a de Havilland **Gnome** turbine has been undergoing flight tests since February 1959. **11** A U.S. Navy HSS model was experimentally fitted with two General Electric T58 turbines and began flight tests early in 1957. **12** H-21B and H-21C versions powered by a 1,425-h.p. Wright R-1820-103; all-up weight 13,500 lb, useful load approx. 4,770 lb; max. no. of seats 22. YH-21D version has two 1,024-s.h.p. General Electric T58-GE-2 turbines.

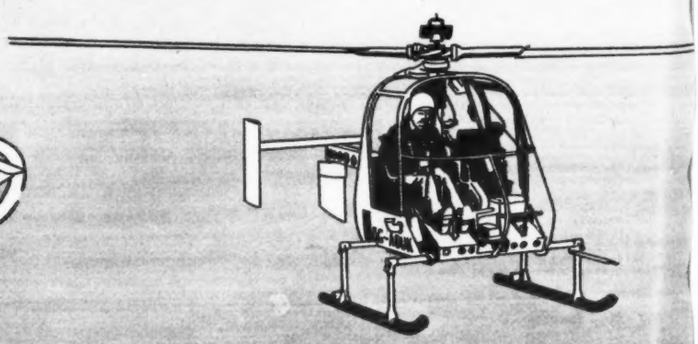
Sud-Aviation *Alouette II* turbine-powered helicopter, large numbers of which are being produced. The five-seat *Alouette II*, powered by a Turboméca *Artouste II*, has received U.S. Federal Aviation Agency type certification.

Turbine- or Ramjet-Powered Helicopters

Type designation	Fairey Ultra Light	Saunders-Roe P.531	Westland Wessex	Sud-Aviation SO.1221 Djinn	Sud-Aviation SE.3130 Alouette II	Sud-Aviation SE.3160 Alouette III	Merckle SM 67
COUNTRY	GREAT BRITAIN	GREAT BRITAIN	GREAT BRITAIN	FRANCE	FRANCE	FRANCE	German Federal Republic
Engines (no. and type)	1×Blackburn Turboméca Palouste 500	1×Blackburn A.129 Mk.3 (or 1×de Havilland Gnome)	1×Napier Gazelle NGa.13	1×Turboméca Palouste IV	1×Turboméca Artouste II	1×Turboméca Artouste IIIB	1×Turboméca Artouste IIB[15]
Max. take-off rating	1×250 gas h.p.	1×963 s.h.p.	1×1,450 s.h.p.	1×240 s.h.p.	1×320/390 s.h.p.	1×700/750 s.h.p. (down-rated to 450 s.h.p.)	1×360 s.h.p.
Max. take-off weight	1,800 lb	4,660/5,000 lb	12,600 lb	1,675/1,760 lb	3,310 lb[13]	4,190/4,630 lb	—
Max. payload (P) or max. useful load (U)	— 843 lb (U)	— —	2,412 lb (P) —	— 880/970 lb (U)	— 1,430 lb (U)	— 1,900/2,340 lb (U)[14]	— —
Max. no. of seats	2	5	14 to 18	2	5	7	5

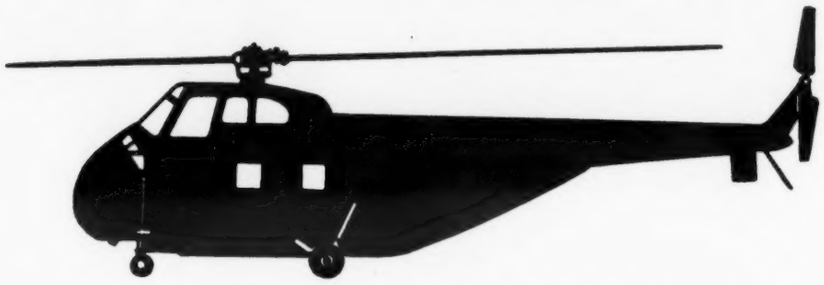
13 The **Alouette II** can operate at a gross weight of 3,530 lb with overload. For 60-mile stages the payload is 1,050 lb, for 180-mile stages 680 lb. **14** Payload for 60-mile stages is 1,540 lb, for 180-mile stages 1,190 lb. **15** It is planned to install a **Artouste IIC** at a later date.

The seven-seat Fiat 7002, powered by a Fiat 4700 turbo-compressor.

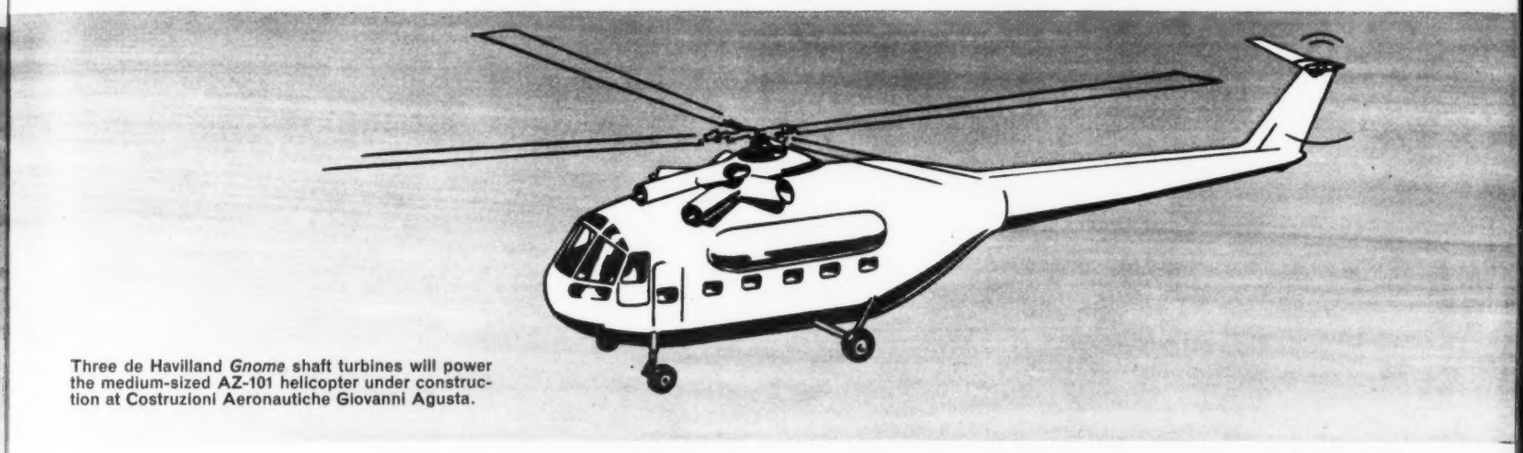


The Fairey *Ultra Light*, powered by a Blackburn - Turboméca *Palouste 500* turbo-compressor.

FRANCE: Sud-Aviation SO-1221 *Djinn*.



GREAT BRITAIN: The Westland *Whirlwind*, which exists in various versions; Pratt & Whitney or Alvis *Leonides Major* engine.



Three de Havilland *Gnome* shaft turbines will power the medium-sized AZ-101 helicopter under construction at Costruzioni Aeronautiche Giovanni Agusta.

Agusta AZ.101	Fiat 7002	Nederlandse Helicopter Industrie H-3 Kolibrie	Aerotécnica AC-14	Bell Model 204[15] U.S. Army: HU-1A Iroquois	Hiller HJ-1 Hornet U.S. Army: YH-32 U.S. Navy: HOE-1	Kaman HU2K-1	Kaman H-43B Huskie[17]	McDonnell 120
ITALY	ITALY	NETHERLANDS	SPAIN	USA	USA	USA	USA	USA
3×de Havilland Gnome	1×Fiat 4700	2×NHI TJ-5 ramjets	1×Turboméca Artouste II	1×Lycoming T53-L-1	2×Hiller SRJ2B ramjets	1×General Electric T58	1×Lycoming T53-L-1	3×AiResearch GTC-85-35
3×~1,000 s.h.p.	1×~550 gas h.p.	2×~60 h.p. equiv.	1×320/390 s.h.p.	1×825 s.h.p. (down-rated to 700 s.h.p.)	2×~44 lb	1×~1,100 s.h.p.	1×825 s.h.p.	—[18]
~17,650 lb	3,090 lb	1,434/1,544 lb	2,645 lb	5,800 lb	1,080 lb	9,150 lb	7,100 lb	6,300 lb
—	—	—	—	—	—	—	—	—
—	1,760 lb	904/1,014 lb	—	—	~540 lb	—	—	—
25 to 30	up to 7	2	5	6 to 8	2	up to 14	—	1

16 Former type designation H-40. The HU-1A has carried loads up to 2,600 lb during flight tests. 17 A derivative of the piston-engined H-43A (HOK or HUK). Kaman has also built a two-seat experimental version, the K-17, with rotor driven by pressure nozzles. The K-17 is powered by a Blackburn-Turboméca **Turmo 600** of about 400 s.h.p., but can also operate with the Boeing XT-60 shaft turbine. 18 The rating of each engine is normally about 85 h.p., but can be considerably raised by water injection and by burning additional fuel at the blade-tip nozzles.

Kaman Aircraft Corporation's HU2K-1 can take up to 14 passengers. The HU2K-1 is powered by a 1,100-s.h.p. General Electric T58 shaft turbine.

Medium-Sized Piston-Engined Helicopters—Gross Weights over Three Tons

Type designation	Westland Whirlwind[10]	Bell Model 61 U.S. Navy: HSL-1	Sikorsky S-53[11] U.S. Navy: HSS-1 U.S. Army: H-34 Choctaw Marine Corps: HUS-1	Sikorsky S-55 USAF and U.S. Army: H-19 U.S. Navy & Coast Guard: HO4S; Marine Corps: HRS	Vertol Model 43[12] USAF and U.S. Army: H-21 Shawnee
COUNTRY	GREAT BRITAIN	USA	USA	USA	USA
Engines (no. and type)	1×Pratt & Whitney R-1340-40 or 1×Alvis Leonides Major 755/4	1×Pratt & Whitney R-2800-50	1×Wright R-1820-84 Cyclone	1×Pratt & Whitney R-1340 or 1×Wright R-1300-3	1×Wright R-1820-103
Max. take-off rating	1×600 h.p. or 750 h.p.	1×1,900 h.p.	1×1,525 h.p.	1×600 h.p. or 1×700/800 h.p.	1×1,150 h.p. (down-rated performance)
Max. take-off weight	7,500/7,800 lb	26,500 lb	up to max. 13,600 lb	7,200/~7,900 lb	11,500 lb
Max. payload (P) or max. useful load (U)	— ~2,200/2,500 lb (U)	— —	— up to 5,200+lb (U)	— 2,250 lb (U)	— ~3,550 lb (U)
Max. no. of seats	10 to 12	4 (Large quantity of anti-submarine equipment)	up to 20	12	up to 16

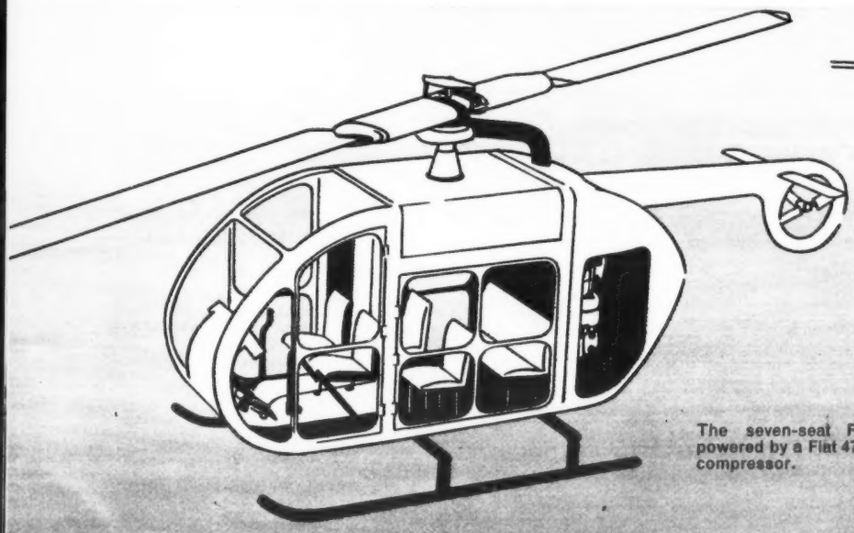
10 Available in many civil and military versions; also in versions powered by a 700/800-h.p. Wright R-1300 engine; a version powered by a de Havilland **Gnome** turbine has been undergoing flight tests since February 1959. **11** A U.S. Navy HSS model was experimentally fitted with two General Electric T58 turbines and began flight tests early in 1957. **12** H-21B and H-21C versions powered by a 1,425-h.p. Wright R-1820-103; all-up weight 13,500 lb, useful load approx. 4,770 lb; max. no. of seats 22. YH-21D version has two 1,024-s.h.p. General Electric T58-GE-2 turbines.

Sud-Aviation *Alouette II* turbine-powered helicopter, large numbers of which are being produced. The five-seat *Alouette II*, powered by a Turboméca *Artouste II*, has received U.S. Federal Aviation Agency type certification.

Turbine- or Ramjet-Powered Helicopters

Type designation	Fairey Ultra Light	Saunders-Roe P.531	Westland Wessex	Sud-Aviation SO.1221 Djinn	Sud-Aviation SE.3130 Alouette II	Sud-Aviation SE.3160 Alouette III	Merckle SM 67
COUNTRY	GREAT BRITAIN	GREAT BRITAIN	GREAT BRITAIN	FRANCE	FRANCE	FRANCE	German Federal Republic
Engines (no. and type)	1×Blackburn Turboméca Palouste 500	1×Blackburn A.129 Mk.3 (or 1×de Havilland Gnome)	1×Napier Gazelle NGa.13	1×Turboméca Palouste IV	1×Turboméca Artouste II	1×Turboméca Artouste IIIB	1×Turboméca Artouste IIB[15]
Max. take-off rating	1×250 gas h.p.	1×963 s.h.p.	1×1,450 s.h.p.	1×240 s.h.p.	1×320/390 s.h.p.	1×700/750 s.h.p. (down-rated to 450 s.h.p.)	1×360 s.h.p.
Max. take-off weight	1,800 lb	4,660/5,000 lb	12,600 lb	1,675/1,760 lb	3,310 lb[13]	4,190/4,630 lb	—
Max. payload (P) or max. useful load (U)	— 843 lb (U)	— —	2,412 lb (P) —	— 880/970 lb (U)	— 1,430 lb (U)	— 1,900/2,340 lb (U)[14]	— —
Max. no. of seats	2	5	14 to 18	2	5	7	5

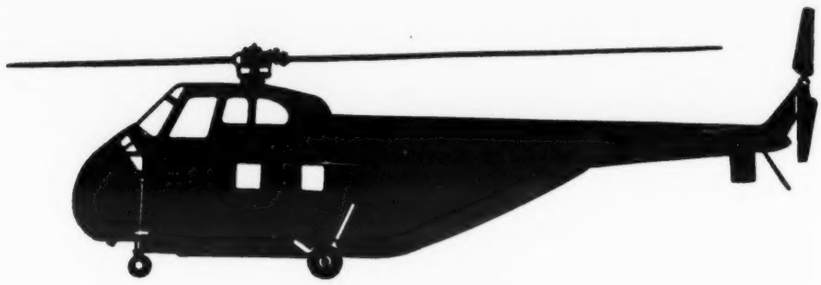
13 The **Alouette II** can operate at a gross weight of 3,530 lb with overload. For 60-mile stages the payload is 1,050 lb, for 180-mile stages 680 lb. **14** Payload for 60-mile stages is 1,540 lb, for 180-mile stages 1,190 lb. **15** It is planned to install an **Artouste IIC** at a later date.



The seven-seat Fiat 7002, powered by a Fiat 4700 turbo-compressor.

The Fairey *Ultra Light*, powered by a Blackburn - Turboméca *Palouste 500* turbo-compressor.

FRANCE: Sud-Aviation SO-1221 *Djinn*.



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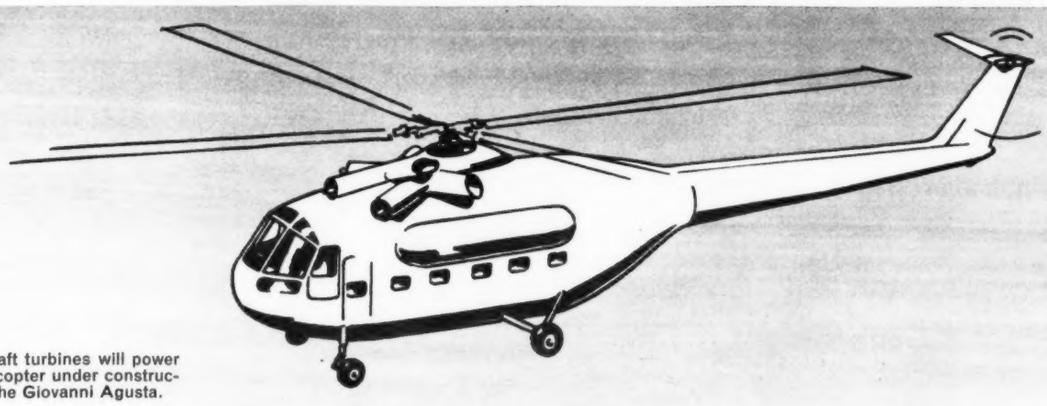

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—	—	—	—	—	—	—	—	—
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25 to 30	up to 7	2	5	6 to 8	2	up to 14	—	1

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Kaman Aircraft Corporation's HU2K-1 can take up to 14 passengers. The HU2K-1 is powered by a 1,100-s.h.p. General Electric T58 shaft turbine.

The West's Heavy Helicopters

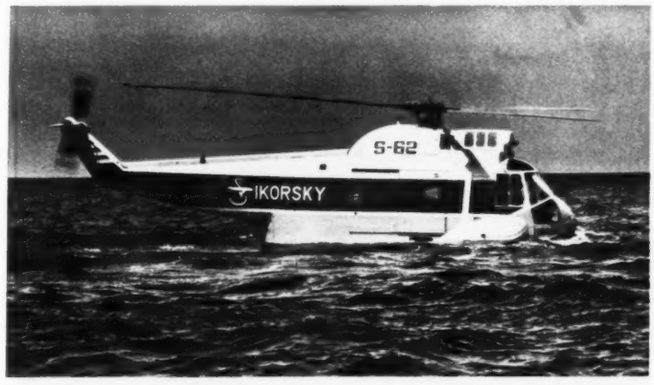
Prototype of the Westland *Westminster* crane helicopter (two Napier *Eland 6* shaft turbines) transporting a section of a bridge for the British Army.

I. Commercial helicopters

The big snag in the commercial helicopter, as everyone knows, is its relatively high seat-mile cost, the direct outcome of its low cruising speed (70 to 85 knots in the types available today). Compared with conventional fixed-wing aircraft, rotorcraft seat-mile costs are at present roughly ten times as high. It is therefore not to be wondered at that designers are developing bigger and bigger rotorcraft, so as to improve profitability by increasing transport capacity per dollar invested. It is also understandable that they should spare no effort to raise cruising speed as far as possible.

Substantial progress has been made in both directions in the most recent rotary-wing types: the single-engine converted military helicopters of recent years, with a seating capacity of at best 12 or 16, are being joined by new designs for 24, 28 or even—in the special case of the *Tyne-Rotodyne*—for 65 passengers. As for cruising speed, the new formula incorporated in the *Rotodyne*, i. e., the compound helicopter or "temporary helicopter," permits of an increase up to 175 knots. In the case of pure helicopters, a careful investigation of aerodynamic conditions, in particular the optimum reduction in rotor disc loading and the use of special blade sections with high critical Mach number at both small and large angle of attack, will doubtless bring further improvements in speed.

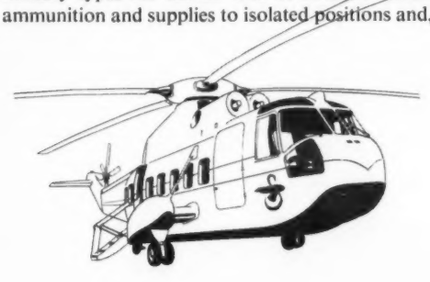
It will be noted that all the newer commercial helicopters are multi-engine designs and in most cases are powered by gas turbines. Adequate flight safety is thus assured even with partial engine failure. In some cases (Sikorsky S-61 and Vertol 107) automatic stabilization systems and full instrumentation are provided to ensure all-weather capability, and fully automatic autopilots for helicopters, which have been under development for some ten years, should also be available in the near future.



The new Sikorsky S-62 amphibious helicopter (one General Electric T58 shaft turbine) in its third element.

II. Military helicopters

The forerunners of the commercial helicopters are in most cases identical military types for assault and commando missions, for the transport of ammunition and supplies to isolated positions and, last but not least, for the



Two multi-engined turbine helicopters for short-haul operations in the early sixties: the American Sikorsky S-61 (two General Electric T58—above) and the French Sud-Aviation SE-3200 *Frelon* (three Turboméca *Turmo IIIB*). Both have a 28-seat layout.

Type designation (Stage of development)	1 Bristol 192 (Production)	2 Westland Westminster (Prototype)	3 Westland Westminster Crane (Project)	Sud-A SE. Frelon produ
COUNTRY	**GREAT BRITAIN**			**FRA**
No. of engines Engine type Max. take-off rating (total) in s. h. p.	2 Napier *Gazelle 2* 3,300	2 Napier *Eland 6* 7,300	2 Napier *Eland 6* 7,300	3 Turbo *Turm* 2,2
Rotor diameter Fuselage length	48′ 8″ —	72′ —	72′ 71′ 4″	49′ 47′
Gross weight in lb Useful load in lb Typical payload/range in lb/n. m.	18,000 7,500 —	36,000 14,700 —	36,000 14,000 11,000/100	17,6 7,7
Max. no. of seats (C = civil; M = military) excluding crew	25 (M)	—	50+ (M)	28 (

1 A commercial version, the 192C, for about 15 passengers, is in preparation; 4 Take-off rating will be raised to 3,300 s.h.p. in the production version by using a **Turmo IIIC**.

6 Turbosha and float u only on tak

The prototype of the Sikorsky S-60 crane helicopter (two P & W R-2800 piston engines) carrying a 4,500-lb bridge span.

Britain's Fairey *Rotodyne* compound helicopter (prototype, powered by two Napier *Eland* shaft turbines, with turbo-compressor and blade-tip jets) can also be used as a "flying crane." The bridge section is 103 ft long.

Projected crane version of the Westland *Westminster*.

The U.S. Navy's Sikorsky HSS-2 amphibious helicopter (two General Electric T58 shaft turbines), military precursor of the S-61 commercial helicopter now under development.

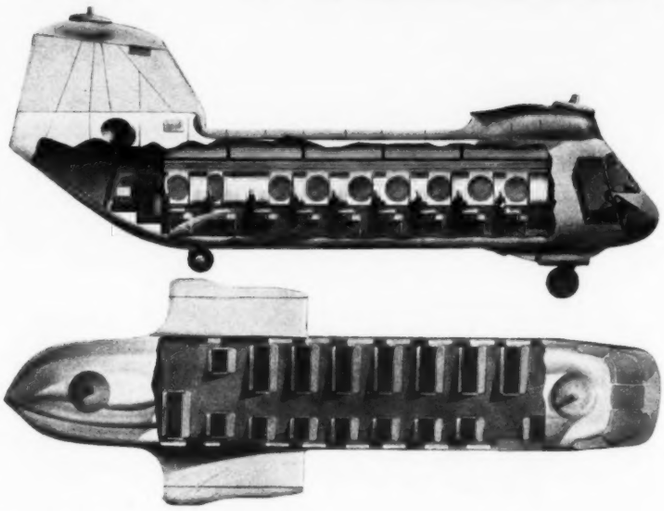
4 Sud-Aviation SE.3200 Frelon (Pre-production)	5 Sikorsky S-56 (Army H-37) (Operation)	6 Sikorsky S-60 (Prototype)	7 Sikorsky HSS-2 (Production)	8 Sikorsky S-61 (Develop-ment)	9 Sikorsky S-62 (Prototype)	10 Vertol 44 (Army H-21) (Operation)	11 Vertol 107 (Prototype)	12 Vertol YHC-1B Chinook (Develop-ment)	13 Fairey Rotodyne (Prototype)	14 Fairey Rotodyne (Develop-ment)
FRANCE	**UNITED STATES OF AMERICA**								**GREAT BRITAIN**	
3 Turboméca *Turmo IIIB* 2,250	2 Pratt & Whitney R-2800 4,200	2 Pratt & Whitney R-2800 4,200+	2 General Electric T58 2,100	2 General Electric T58 2,100	1 General Electric T58 1,050	1 Wright 977C9 *Cyclone* 1,425	2 General Electric T58 2,100	2 Lycoming YT55 3,200+	2 Napier *Eland* 5,600 (+4 Jets)	2 Rolls-Royce *Tyne* 10,500 (+4 Jets)
49′ 2″ 47′ 6″	72′ 68′ 5″	72′ —	62′ 54′ 9″	— —	53′ 44′ 5″	2×44′ 52′ 6″	2×50′ 44′ 7″	57′+50′ 48′ 5″	90′ 58′ 8″	104′ 64′ 6″
17,600 7,700 —	31,000 ~10,000 —	— — 11,000+/100	— — —	— — —	7,900 2,855 1,500/170	14,000 5,345 —	18,400 — 5,500/200	— — 5,500/200	33,000 — —	50,000 — 15,000/220
28 (C)	36 (M)	—	—	28 (C)	12 (M)/9 (C)	15-19 (C)	24 (C)	40 (M)	48 (C)	65 (C)

6 Turboshaft version projected; 7 Suitable for all-weather flying, anti-icing system for rotor blades, folding rotor blades for carrier-based operation; 8 Civil version of the HSS-2 with similar dimensions; 9 Amphibious helicopter with flying boat hull and float undercarriage; 11 Suitable for all-weather flying, automatic stabilization, can land on water; 12 It is planned to raise engine rating to about 3,800 s.h.p. during development; 13 and 14 Compound helicopters operating as rotary-wing aircraft only on take-off and landing (with blade-tip jets).

Up to 25 troops can be transported in the British Army's Bristol 192, now in production. A 15-seat commercial version is being prepared under contract to BEA. Engines: 2 Napier *Gazelle 2* shaft turbines.

Prototype of the Sud-Aviation SE.3200 *Frelon* helicopter at the 1959 Paris Air Show. Engines: Three Turboméca *Turmo IIIB* shaft turbines.

A Vertol 107 (precursor of the U.S. Army's *Chinook* helicopter) undergoing trials as a commercial transport. Engines: two General Electric T58 shaft turbines.



Seating plan of 24-passenger Vertol 107.

Vertol 44 commercial helicopter (Wright *Cyclone* engine) for 15 to 19 passengers, over Philadelphia, Pennsylvania.

rapid evacuation of wounded or the sea rescue service. The Bristol 192, for example, can carry up to 25 fully-equipped troops, the Sikorsky S-56 as many as 36 into the combat zone, and the Vertol *Chinook*, still under development, will have a capacity for up to 40 men or a large tactical surface-to-surface missile. For naval warfare—in particular for anti-submarine operations—there are a number of special types, such as the turbine-powered amphibian Sikorsky HSS-2, which is equipped with automatically folding blades for operation aboard carrier vessels.

The role of preparing the way for the rotorcraft in air transport fell to the military helicopter because only the Great Powers' defence budgets can provide the funds to cover the high development costs, either directly or by means of nourishing production contracts. No manufacturer could assume the risk of developing a large helicopter without this backing.

III. Crane helicopters

In this special category, which covers both military and civil tasks, rotorcraft are capable of astonishing feats: the carriage of high tension masts, heavy pipes, field guns, medium-sized rockets, heavy pontoons, bulky bridge sections . . . the accompanying pictures illustrate only some of their achievements. The Sikorsky S-60, for example, can lift up to 5½ tons, and the Westland *Westminster Crane* will carry more than 6 tons over short distances. These are in no way records, as a Russian Mil Mi-6 has already lifted a load of 10 tons to an altitude of nearly 15,000 feet.

The most telling factors in the typical crane helicopter are neither cruising speed nor range. What counts here is lifting power and appropriate design: the four-point widespread undercarriage as in the *Westminster*, a swivelling pilot seat (crane seat) as in the Sikorsky S-60 etc.

*

Thus rotorcraft have grown from modest beginnings to the sizes shown in the accompanying table. They have rotors 50 ft, 65 ft or even more than 100 ft in diameter and will have gross weights of up to 50,000 lb. Launoy and Bienvenu's "toy" has developed into a giant.

The Rotorcraft in Warfare

by General L. M. Chassin, Paris

The major disadvantages of conventional aircraft lie in their method of take-off and landing, which requires longer and longer runways as weights and speeds are increased, and in their inability to hover.

To take off and land vertically and to remain in the air at zero speed is a problem which inventors have been trying to solve since the early days of aeronautics. As regards improvements to conventional aircraft it is hoped that a solution will be achieved with VTOL and convertible types, but for the time being the helicopter is the only answer.

Before considering the possible usefulness of the helicopter in warfare it is pertinent to give a brief survey of its technical disadvantages; certain of these may one day be overcome, but for the time being they restrict its military applications.

Firstly, the helicopter's speed in level flight will always remain limited by reason of its fundamental principle of operation.

Secondly, it lacks stability. It is true that helicopters can be fitted with stabilizers and autopilots. But these devices are very heavy. For the moment the instability of the helicopter and the difficulties of piloting it remain serious handicaps, particularly in lightweight types.

Thirdly, a rotorcraft needs roughly three times more power to fly than a fixed-wing aircraft of the same weight and speed.

Apart from its intrinsic defects the helicopter has a certain number of other drawbacks: it still requires a great deal of expensive maintenance work; it has a tendency to vibrational periodicity and structural complexity due to the need for intricate transmission systems.

But, compared with these defects, many of which are well on the way to elimination, the helicopter possesses enormous advantages.

First of all, it is still the only aircraft with complete freedom of manœuvre in all three dimensions of space. Since it can take off and land without forward speed, the helicopter requires practically no ground organization. It can fly at any speed between zero and maximum, and there are many occasions when its ability to fly slowly can be extremely useful. It can carry both internal and external loads and set them down at otherwise completely inaccessible points, if necessary without making contact with the ground. Its useful load can be very easily increased (though this, of course, lowers its ceiling); it can fly in any direction, forwards, sideways or backwards, and can thus make evasive manoeuvres which lessen its vulnerability.

Last, but by no means least, it can land without incident if its engine fails, using its rotor blades as a parachute. Nor should one forget the complete visibility enjoyed by its crew or the ease with which it can be converted for marine operation simply by fitting floats.

Military applications

Given the technical characteristics enumerated above, what are the military applications of the helicopter in the three kinds of war which it may be necessary to wage: nuclear warfare, conventional warfare and subversive warfare?

These applications can be divided into four groups: service missions in general, army missions, air force missions and naval missions.

The *general applications* are basically liaison, observation and reconnaissance duties, special missions such as the transport of agents, and finally, rescue missions such as the evacuation of wounded or of personnel in difficulties.

Naval applications consist in anti-submarine operations, mine-spotting, the protection of convoys, air-sea rescue, artillery spotting and amphibious landing operations.

Ground forces can use the helicopter for carrying supplies to troops, for the transport of commandos or larger units, the evacuation of encircled units, the transport of ordnance or guided missiles (crane helicopters), control of ground movements, laying telephone cables and lastly, the direct or indirect support of ground warfare (airborne artillery).

Finally, *air force applications* include reconnaissance for landing-grounds, recovery of valuable or secret material from aircraft which have crashed or made forced landings, and the transport of special equipment. To these missions has recently been added that of protecting helicopter operations.

Nuclear Warfare

One of the most important consequences of the use of nuclear weapons will be the almost total disruption of ground communications. It will therefore be impossible to use normal supply lines to provision armies operating on a vast battlefield polluted by radioactive dust. The same applies to troop reinforcements, the evacuation of wounded and the provisioning of entire populations.

In such cases there are two possible methods of getting supplies and reinforcements to the spot: parachuting and helicopter transport. For the transport of supplies of all kinds (arms, ammunition, medicaments, food, petrol, oil etc.), the former appears more economical and efficient wherever troops are relatively concentrated, helicopter operations being strictly reserved for "door-to-door" transport, which may be necessary in certain tactical situations. As for

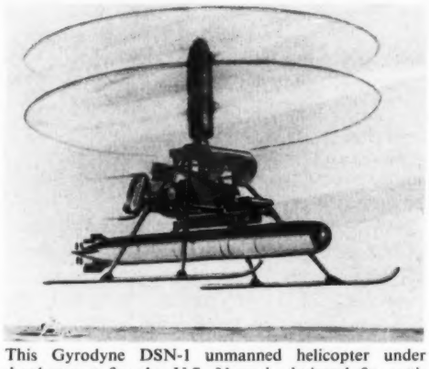
A U.S. Army medium-weight helicopter, the Bell HU-1 *Iroquois* (formerly the Bell H-40), during a combat exercise

In marine warfare the helicopter is an ideal weapons system for anti-submarine operations. Sikorsky has developed the HSS-2 all-weather amphibious helicopter, powered by two General Electric T58 shaft turbines, for the U.S. Navy.

troop reinforcements, it should be remarked that, however much training is cut down, parachuting in most cases requires expert personnel who should, in principle, be reserved for specialized missions. Finally, the helicopter will remain the solution to the problem of evacuation as long as it is the only aircraft capable of landing and taking off at any spot.

In the *tactical field*, contrary to what one might think at first glance, the helicopter will no doubt be the means of transport least affected by the appalling conditions of the new battlefield, with its exploding rockets, its vast craters, its contaminated zones varying with the prevailing winds, and its "dynamic" quality due to the movements of units alternately concentrated and dispersed. The helicopter, flying low and slowly through the dust and smoke, finding its way by ground landmarks, hurrying out of the radioactive zones so as not to expose its crew to contamination, will probably remain capable of performing not only its logistic missions, but also those of observation and reconnaissance. It will certainly have less difficulty than conventional aircraft in operating without a base, and its ability to change its station every day prevents its becoming an easy prey to the enemy's guided missiles. It may even perhaps be the only aircraft able to operate when fixed-wing aircraft, deprived of the considerable infrastructure which they will always need, are grounded for lack of the means to put them into action. And perhaps it is to the helicopter that troops will finally turn for a support on the battlefield which the fixed-wing aircraft will no longer be able to give. It is then that we shall see heavy armoured helicopters carrying not only recoilless cannon, as today, but also missiles of the *Honest John* type, perhaps even with nuclear warheads. It is easy to imagine the fire power and mobility of such a weapons system! Today, more than ever before, mobility will be the key to supremacy in a nuclear war on land.

At sea the use of the nuclear weapon will be less revolutionary than in other sectors. There is, however, the risk that surface warfare will be made so uncomfortable that the submarine will become tomorrow's "capital ship" and all the large surface vessels will be relegated to the scrap-heap. One can even foresee the appearance of mighty nuclear-powered submarine transports to replace heavy cargo ships which will by then have become too vulnerable. The helicopter is particularly suitable for anti-submarine warfare, its only handicap lying in its short range. If, in a conventional war, the problem can be solved by the use of helicopter carriers, such vessels would soon become useless in a nuclear war. The solution for the future therefore lies in the development of a machine combining the characteristics of the helicopter with those of the fixed-wing aircraft. It appears that such a solution is not far away, but for the time being we must content ourselves with what already exists.



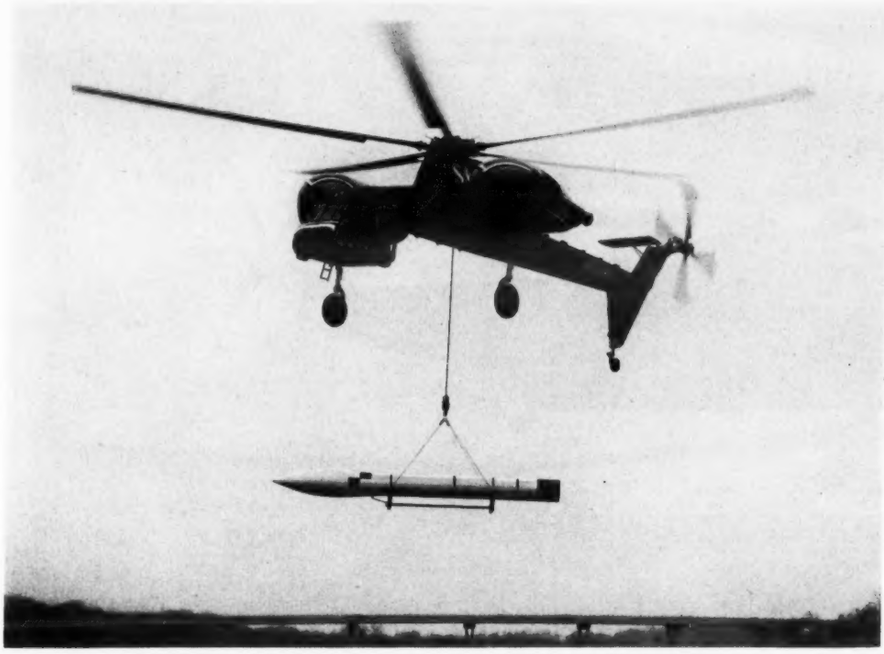
This Gyrodyne DSN-1 unmanned helicopter under development for the U.S. Navy is designed for anti-submarine operations from the decks of destroyers.

Finally, the uses to which the *air force* can put the helicopter are somewhat limited, in nuclear as in other forms of war. If, however, light tactical support fighters are to survive in this inferno, they will have to use helicopters for all kinds of provisioning and for liaison purposes. The evacuation of wounded will remain, as already mentioned, a specialized mission.

An *Alouette II* helicopter produced under licence by Republic takes off from the deck of the destroyer *USS Mitscher* to launch the homing torpedoes suspended under its fuselage against an "enemy" submarine.

Conventional warfare

In conventional warfare the helicopter will have to perform all the missions enumerated in the previous section. The main objection to its use lies in its vulnerability; it will therefore clearly require protection for certain front-line transport missions, and operations will have to be prepared and planned as in the case of normal air transport. The helicopter's duties will consist mainly of the routine transport of supplies to fighting divisions; the provisioning and evacuation of encircled units; and finally, assault transport. In the first application the theatre command must never forget, as it all too often does, that the helicopter is an expensive piece of equipment to be used only when there is no other that can do the job; in the second,



Heavyweights : The Sikorsky S-60 "flying crane" transporting an *Honest John* artillery missile.

it will be remembered that the helicopter was successfully used to evacuate marines at Chosen, during the Korean War; in the third role, during the same war, Sikorsky S-55 helicopters took practically inaccessible ridges by surprise, landing directly on the target.

But the helicopter will, in particular, be used immediately behind the combat area for organizing and maintaining the lines of communication; laying telephone and telegraphic cables, controlling traffic, transporting ordnance, metal bridges and all heavy equipment which cannot be carried by fixed-wing aircraft.

In naval warfare the helicopter's role will be of considerable importance, for it can be based not only on special carriers but also on nearly all classes of vessels. In a conventional conflict supremacy at sea will be vital and convoys, which will continue to travel the seas as in the past, must be protected against submarines. Here the helicopter will no longer be handicapped by its short radius of action. It can spot and attack the enemy itself and will be one of the most efficient members of hunter-killer groups; its ability to hover will enable it to lay sono-buoys with accuracy and, once the enemy has been detected, to drop bombs or depth-charges.

In air force service the helicopter will carry out the classical missions of liaison, transport and evacuation in difficult terrain.

Subversive warfare

Subversive war, which was waged by Mao's Communists in China, later by the Viet-Minh in Indo-China, and which the fellaghas are continuing to fight in Algeria, is for the moment characterized by the fact that the enemy possesses no aircraft; consequently, supremacy in the air is the monopoly of the "forces of order." It has often been asked why, until the present at any rate, rebels in Asia and Africa have never tried to use aircraft, when they have shown themselves perfectly capable of operating artillery or anti-aircraft guns. The answer is that the aircraft is an expensive weapon, requiring carefully selected, highly-trained personnel and a complicated and highly-specialized ground organization. Given the men and money at their disposal, the leaders of the various rebellions felt, quite rightly, that aircraft operations would yield very poor results in their hands and that it would be wiser to utilize their potential in other ways. On the other hand, the Europeans have not always known how to take advantage of their superiority in a field of such capital importance.

However, they are gradually learning, and France, with eight years' experience of war in Indochina, has evolved a certain number of principles for the employment of aircraft in subversive warfare and made intelligent use of helicopters in Algeria, where she has at her disposal a wide range of equipment.

With helicopters, as with all new equipment, there has been no delay in diversification and enlargement. Today they can be divided, somewhat arbitrarily, into three classes, according to weight: light helicopters weighing less than 2 tons, such as the *Djinn*, the *Alouette*, the Hiller 360 and the Cessna CH-1; medium-weight helicopters (2 to 6 tons) such as the Bell HU-1 *Iroquois*, the Sikorsky H-19 (S-55) and the Bristol *Sycamore*; and lastly, heavy helicopters (over 6 tons), such as the Sikorsky H-34 (S-58), known by the French in Algeria as the *Mammouth*, the Russian Yak-24 and Mi-6, the Bristol 192 and the Sikorsky S-60 flying crane.

Having begun operations with light and medium-weight rotorcraft (Bell H-13s, *Alouette IIs* and H-19s), French troops have since received H-34s, which will eventually be superseded by a French helicopter, the Sud-Aviation SE.3200. Thanks to these models a new method of warfare has been evolved and the missions of the light aircraft extended.

For practical purposes, a helicopter assault detachment consists of eight H-34s, which can transport a commando unit over a distance of more than six miles in 20 minutes. Surprise attacks can be made with large numbers of troops and yet remain flexible enough to counter enemy reactions well in advance. Operations of this kind obviously require perfect coordination of the action of all concerned (infantry, artillery, support aircraft), reliable radio communications and highly-trained crews.

In the assault role the helicopter also needs considerable fire support in view of its extreme vulnerability during approach flights and final hovering, the armaments at the rebels' disposal, and the frequent uncertainty regarding the exact position of the bands to be surrounded.

It is for this reason that the command has been obliged to heavily arm a number of H-34s to supplement the normal means of fire support (artillery, bombing, strike fighters) in protecting helicopter operations.

Each helicopter assault detachment now contains an H-34 armed with a 20-mm cannon and two machine-guns; thus equipped, it is highly efficient, since it is the perfect observation post, can select its altitude to give the best sighting angle, and direct powerful and sustained fire onto one spot, flying round the target at low speed.

In addition to the mission described above, all the classical missions of the helicopter are to be found in subversive warfare, in particular the control of ground operations, where it serves as a flying command post in the absence of enemy aircraft. In operations such as those carried out by France in Algeria, the helicopter has become a necessary weapon whose influence is often decisive.

The Vertol YHC-1B *Chinook* is being developed for the U.S. Army. It will be able to transport loads of 3 to 6½ tons or 40 fully-equipped troops.

The future

What is the military helicopter's future? Mention has been made of its inherent defects and of those which can be corrected. It is certain that within a very short time helicopters will be able to fly at night and in any kind of weather and that they will accept heavy armour-plating and weapons. But they will always be handicapped by their inability to fly at high speeds, and their military future is, in the writer's opinion, to a great extent linked with that of the convertible aircraft.

We shall soon be able to form a judgment on the latter from results obtained with the prototypes now undergoing tests in the United States. If the problem can be solved with a high enough degree of safety and without too many mechanical complications, it is very likely that the helicopter's military future will be threatened. But this is still a long way ahead.

The

Gnome

is in production for a number of helicopter applications

THE DE HAVILLAND ENGINE COMPANY LIMITED, LEAVESDEN, HERTFORDSHIRE, ENGLAND

Rescuing an injured mountaineer on the Säntis.

Life-Savers in the Alps

The Swiss Air Rescue Guard

"July 5th, 1959: A Swiss Alpine Club guide leading a mountaineering party fell 300 feet down the Guppen Wall (Glärnisch massif) and was seriously injured. Another guide was parachuted to his aid, and a Piper Super Cub *landed on the Glärnisch Glacier. As the wall is almost perpendicular, the injured man could not be carried to the aircraft. The rescue guide therefore prepared a landing space for a helicopter and, after making sure the injured man was safe, climbed round to the glacier and was flown back to base by the waiting Piper. Next he took off in a Bell 47 helicopter, landed by night in extremely exposed terrain at 7,200 feet altitude, picked up the casualty and accompanied him to Glarus hospital."*

This brief factual report by Swiss mountain guide A. Kurz reveals clearly enough the difficulties and dangers of rescue work in the high mountains, as well as the efficient resources which modern engineering has placed in the hands of the mountain rescue service.

Yet it is not many years since the Swiss search and rescue services were centralized. Although the duel between rescuer and mountain goes back to the earliest days of mountaineering, the *Swiss Life-Saving Society* was not founded until the spring of 1933; even then the young society did not immediately engage in mountain operations, but turned its attention primarily to rescuing the drowning, a natural preoccupation in view of the large number of lakes in the country.

Nevertheless, Dr. R. Bucher, President of the Life-Saving Society, later succeeded in interesting his organization in mountain rescue work, in particular using aircraft. Bucher argued that the precious time wasted by ground rescue columns in reaching the scene of an accident could be reduced to a minimum by the use of aircraft, and this argument was accepted without opposition.

At the end of April 1952 the Life-Saving Society decided to set up the *Swiss Air Rescue Guard*, which is thus not an independent organization, but supplements the older mountain rescue services (Swiss Alpine Club, Swiss Ski Association).

The pilots of the Rescue Guard immediately began preparing themselves for operations in the high mountains—internationally known "glacier pilot" Hermann Geiger made his first landing on the ice in May 1952—while the Royal Air Force organized a training course for Swiss parachutists at RAF Station Abingdon in the summer of the same year.

After systematic operational exercises in the Bernese Oberland and the Diavolezza region, the first practical rescue missions were flown in February 1953. Swiss pilots gave their assistance in the Dutch floods and provided such convincing proof of their skill that the Rescue Guard was requested to help set up similar organizations in Spain, France and Austria.

*

The Swiss Air Rescue Guard demonstrates the lowering of an avalanche dog onto a "snowfield" during an exercise above Lake Zurich.

The *rotorcraft* did not enter service with the Rescue Guard until 1956, when the Swiss Cooperative Association donated a Bell 47J, today stationed at Sion. The Rescue Guard has also made charter agreements for the use of helicopters belonging to private companies (e.g. Heliswiss, Berne), and the cash obtained through the Cooperative Association's collection has been used to purchase rescue equipment, which is stored in three depots—Kloten, Sion and Lausanne—provided free of charge by Swissair.

Picking up a basket containing a stretcher case (exercise).

There is no need to recall that the helicopter is better suited than any other category of aircraft for operations in high mountains. The operating dangers awaiting it at these altitudes will also be fairly well known to *Interavia* readers. Yet there is one difficulty encountered by mountain rescue missions which is not generally realized. Although the ground rescue columns working with the helicopter have first class mountaineering experience, they are frequently less versed in the aircraft's operating requirements. This applies even more to amateur mountaineers who find themselves in danger—even if they are then physically capable of preparing the ground for a helicopter landing.

To help remedy this situation, the Swiss journal "Der Lebensretter" last year published a very instructive article by the Heliswiss Chief

Pilot [1], whose counsels will be found valuable not only in Switzerland, but in all other countries where helicopters are used for mountain rescue purposes.

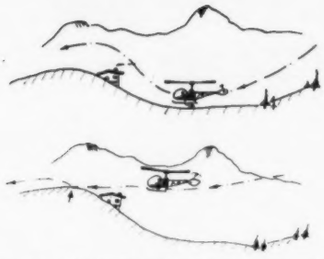
First he explains to the layman that the lower air density at increasing altitudes adversely affects the helicopter's manoeuvrability and its engine performance, so that care must be taken when selecting a landing point to see that it is free of obstructions and that the helicopter will be able to land and take off against the wind. Then special stress is laid on the necessity for providing some form of makeshift wind direction indicator, as none of the signs which reveal the direction and force of the wind in open country (smoke, lines of washing, grazing cattle, etc.) are present in high mountains.

The author then turns to the typical dangers presented by snow drifts and the optical illusions created by the sun shining on snow-covered surfaces. New snow not only smoothes out cracks, crevasses and rocks, but also can be blown up by the rotor downwash, thus completely obscuring the pilot's view. The reflection of the sun from wide snowfields is particularly harassing to the pilot who must approach his landing ground against the sun. But the most treacherous lighting conditions occur when the sun is veiled by a relatively thin cloud layer, and its rays do not directly reach the surface of the snow. It is then virtually impossible to judge altitude and distance.

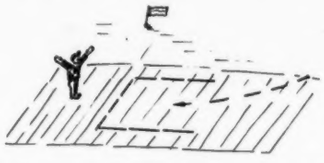
Under the lighting conditions just described, the pilot's task is greatly facilitated if the landing ground is clearly marked, and a competent person on the ground can direct the whole landing operation.

Of particular interest is the advice on how makeshift materials can be used for signalling purposes: a landing ground can be marked out by skis set upright in the snow, letters can be formed with the aid of cloths, clothing etc. held down by stones, wind direction can be indicated by burning rubber, fuel etc., a wind flag can be made by fixing a shirt or other garment to a stick at two points to ensure that it flutters correctly.

Pilot Müller thus tackles his instructional task from a very practical angle. The reader is carried back to his Boy Scout days ... and finds himself almost longing to be in a position to make use of his new knowledge.



Proper selection of the landing spot is vital to success. It is *wrong* to expect the helicopter to land or take off on a steep slope (above), as this demands higher engine performance. The *right* landing spot is on top of a hill (below), as here there is also less snow, and the area to be trodden down is smaller.



Drawing of a snow landing field for helicopters: the snow must be trodden flat by means of skis over a length of at least 80 ft, as the helicopter's tail rotor could otherwise be damaged by loose snow. In the centre of this area nine skis—bindings downwards—are set up in a U-shape, and a wind flag (ski stick with scarf, etc.) is improvised 65 ft from the centre. The landing director (arrow) stands at the end of the landing field.

[1] "Der Gebirgsrettungsdienst mit Helikopter", by E. Müller; "Der Lebensretter" No. 4, December 1958.

*

Ground signals to be used in the search and rescue service:

These signals, which notify the pilot of the situation at the scene of the accident and of the type of assistance required, are made with the aid of any suitable material to hand: skis, ski sticks, garments weighted down with stones, soot, sawdust, etc. The letter I in brackets denotes an international signal, the letter M a signal used in the mountain rescue service. (Table from "Der Lebensretter," official organ of the Swiss Air Rescue Guard, December 1958.)

To be used by persons in distress

- Unable continue (I)
- Require (more) rescue crews (M)
- Medical aid required (seriously injured) (I)
- Ambulance and medicaments required (I)
- Blood plasma required (M)
- Oxygen equipment required + spare bottles (M)
- Avalanche dog required (M)
- Avalanche probes and spades required (M)
- Ropes and rescue equipment required (M)
- Food and water required (I)
- Maps and compass required (I)
- Signalling lamps and radio batteries required (radio set) or signalling cloths (I)
- Lighting equipment required (M)
- Require bivouac equipment (M)
- Show us the way (I)
- Going in this direction (I)
- Aircraft required (indicate direction of wind) (M)
- Helicopter required (mark landing point) (M)
- Will try to take off (I)
- Aircraft badly damaged (I)
- Fuel and lubricant required (I)
- Mechanic required (I)
- No (I)
- Yes (I)
- Not understood (I)
- Everything O.K. (I)

To be used by ground search crews

- Operation completed (I)
- All persons located (I)
- Only some of persons located (I)
- Nothing located, continuing search (I)
- Continued search impossible; returning to base (I)
- Proceeding in two groups in direction of arrows (I)
- Learnt that accident (persons, aircraft) is in direction of arrow (I)

A Light in the Dark

Reflective signs of one kind or another are no novelty. They have been used on vehicles, for traffic signs, and in railway signalling systems for very many years and in many countries. But it is only during the past ten years or so that a material has been developed which, when bonded onto practically any smooth surface such as rubber, aluminium or steel, is unaffected by water or corrosion.

There are many possible uses for reflectors of this kind, but one of the interesting applications is in air-sea rescue operations which have often been unsuccessful in the past because such items as lifeboats, rafts, rubber dinghies, oars and lifebelts do not reflect light and are practically invisible even when they are caught in a searchlight beam.

One of the most widely-known retro-reflective materials is marketed under the tradename *Scotchlite* by the Minnesota Mining and Manufacturing Company, (3M Company). Scotchlite consists of extremely thin flexible metallic sheeting on to which is bonded a smooth layer of minute glass spheres. These spheres bounce light back to its source with a reflective power equivalent to about 185 times that of white paint and under any angle of incidence up to some 70 degrees.

Scotchlite has been tested under many different conditions, and one interesting air-sea rescue operation was staged by the Royal Netherlands Air Force over a 40 square mile area of the North Sea in 1958. A one-man dinghy fitted with a small patch of retro-reflective material and carrying a Sarah homing device was released in the supposed disaster area, and a Neptune plane was detailed for the rescue. The pilot homed on the Sarah transmitter and switched on his landing lights when he was still about two miles away from the dinghy. A few seconds later, the pilot reported to the Valkenburg Air Station near The Hague that he had the dinghy in sight and, his mission accomplished, flew back to base.

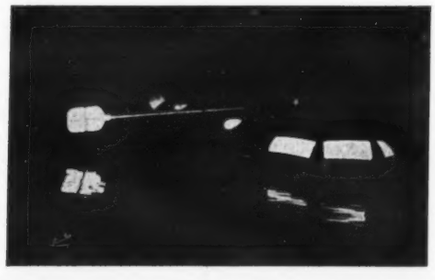
Three minesweepers which were also in the same area were then ordered to find and recover the dinghy. Bridge projectors were used and the dinghy was sighted almost immediately at a distance of over two miles.

Another interesting property of retro-reflective material is the fact that it improves radar reflection from the objects to which it is applied. A series of experiments has been carried out in Holland to evaluate the efficiency of Scotchlite in this respect, and it has been found that over short distances radar reflection is definitely better from any surface covered with this material.

There is little need to dwell on the many applications which retro-reflective material has for route and seaway markings because it is of great value in practically every situation where visual or radar identification is essential. Reflective road signs save lives, and since it is now possible to equip all airborne life-saving apparatus with Scotchlite or similar sheeting, aircrew and passengers in the ditch stand a better chance of quick discovery and rescue.

Men at sea in bright orange yellow life jackets. The jacket on the left is fitted out with retro-reflective material and the striking difference in visibility shows how effectively Scotchlite can be used for air-sea rescue operations.

A one-man rubber dinghy with reflective markings. The dinghy is of a vivid orange colour and the man wears a light grey coat. The paddle blade is also reflectorized and enables the passenger to give signals by waving it overhead.



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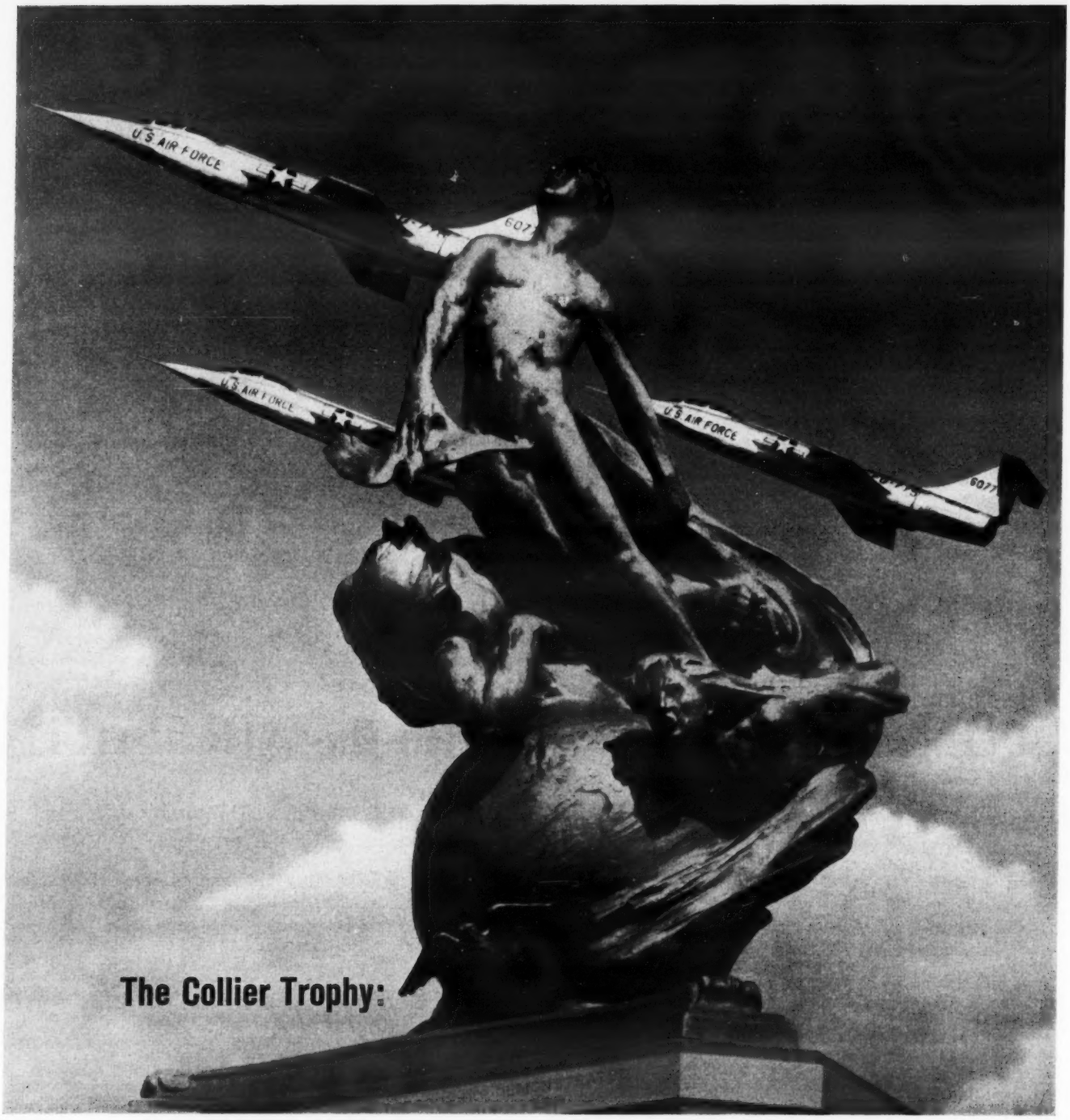

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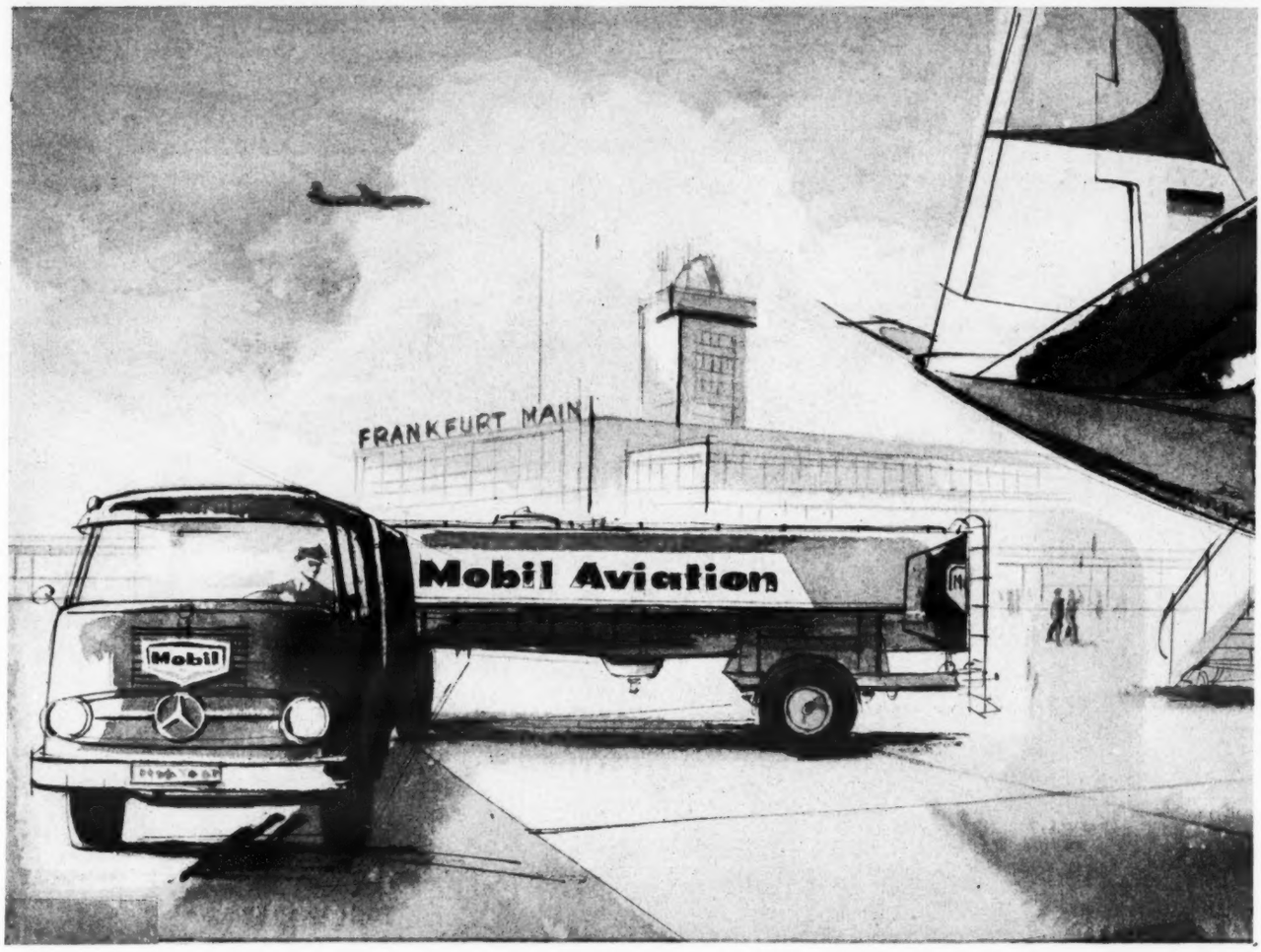

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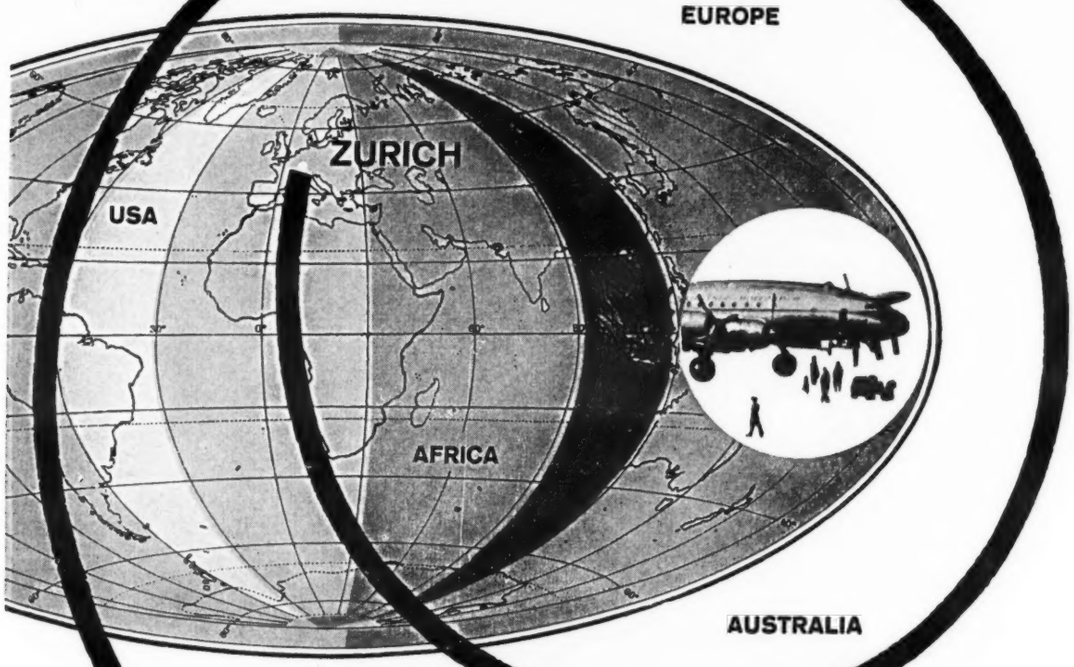

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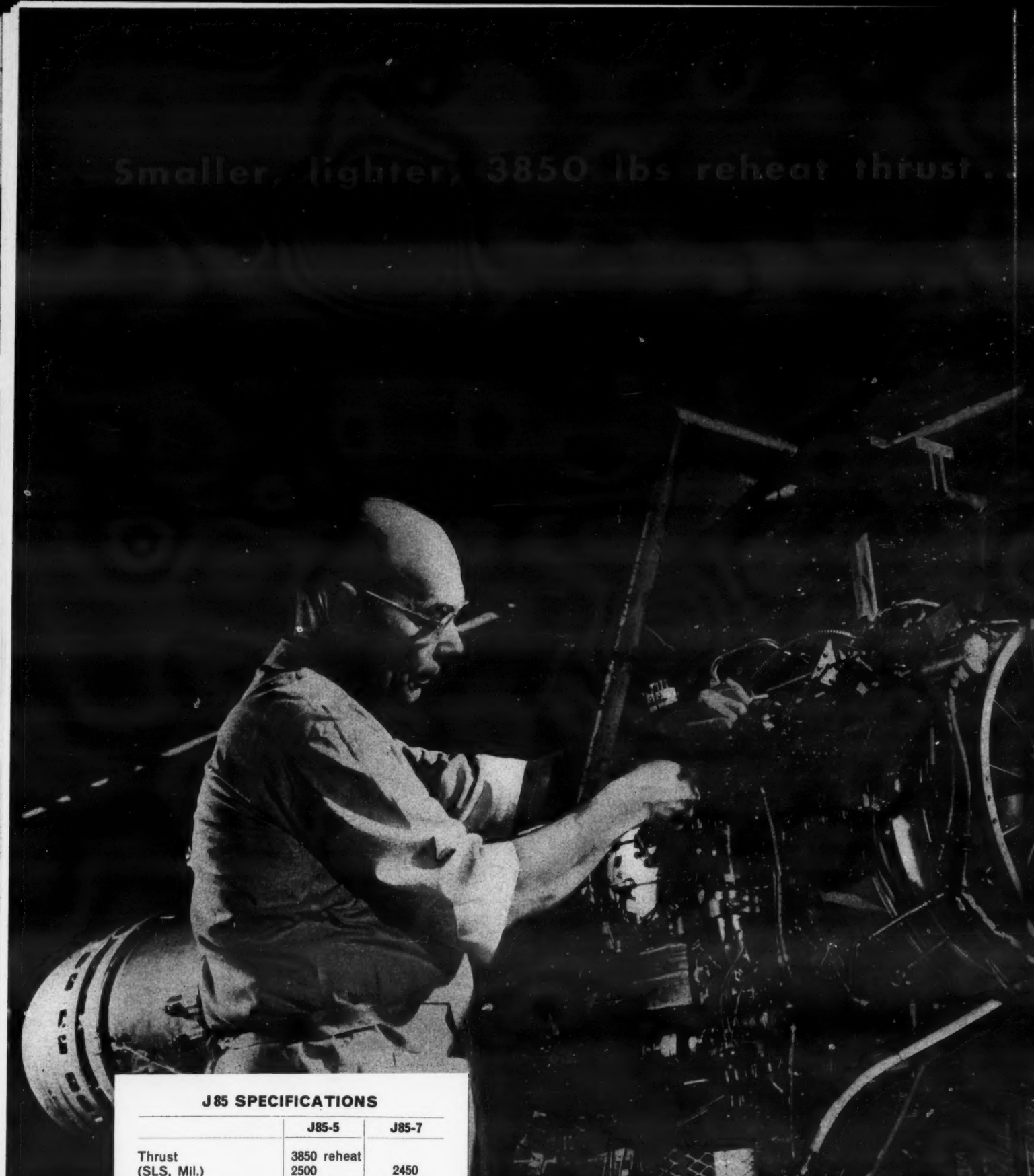

J85 SPECIFICATIONS

	J85-5	J85-7
Thrust (SLS, Mil.)	3850 reheat 2500	2450
SFC	classified	classified
Weight (lbs)	525	325
Length (in.)	104	39.3
Max. Flange (in.)	21	17

General Electric J85 engines are now in production at the Company's Small Aircraft Engine Dept., Lynn, Mass.

NEW

General Electric J85 turbojet helps reduce airframe size, weight, cost... boosts mission performance

SMALLER AND LIGHTER than comparable turbojets, General Electric's new J85 reduces airframe size, makes possible significant savings in airframe weight . . . corresponding reductions in airframe costs.

RATED AT 3850 LBS REHEAT THRUST, and 2500 lbs dry thrust, the J85-5 weighs only 525 lbs. Its missile counterpart, the J85-7, delivers 2450 lbs thrust . . . weighs only 325 lbs.

SHORT AND COMPACT, with a better than 7 to 1 thrust-to-weight ratio and low SFC, the J85 makes possible greater mission capabilities.

PERFORMANCE PROVEN, the J85 has accumulated more than 6000 test hours. On North American's T-39 utility transport, individual prototype (50-hr) YJ85's have logged over 85 hours of engine flight time before overhaul.

DURING ALTITUDE TESTS at Arnold Engineering Development Center, the J85 has exceeded thrust and SFC guarantees. At Wright Air Development Center rugged environmental tests have demonstrated the J85's low temperature starting and accelerating characteristics.

THESE EXAMPLES are typical of the vigorous flight, field and factory tests that have verified J85 ruggedness, reliability and safety margins.
The J85 has been developed under USAF contract and is now in production.

A NEW ILLUSTRATED BROCHURE that describes General Electric's J85 engine is now available. For your copy, write Section 233-23, General Electric Company, Schenectady, N.Y.

McDONNELL'S GAM-72 DECOY MISSILE, powered by General Electric's J85, will give the U.S. one of today's most effective diversionary weapons. The GAM-72 is shown above being air dropped from a B-47 during flight test.

NORTHROP'S N-156F " FREEDOM FIGHTER " AND T-38 " TALON ", TRAINER—With lightweight, compact General Electric J85 engines, these high performance, low cost aircraft offer significant airframe size and weight savings.

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SURVIVAL, FOR US
AS FOR THE CHAMELEON,
DEMANDS VERSATILITY

You cannot take a chameleon by surprise. It can always adapt itself to the prevailing conditions. It owes its survival to this adaptability. The same principle applies in modern warfare. A defence system which is flexible in application is less likely to be defeated than one which is not.

THE MISSILE DOES TWO JOBS

English Electric designed their guided missile, Thunderbird, with this principle of versatility firmly in mind. Thunderbird can be used in two ways. As a permanently-sited static weapon functioning in one position for as long as it is operationally required there. But should the need arise—and attack seldom hits us where we are expecting it—it can be redeployed wherever it can be of greatest service.

Thunderbird can be moved easily and quickly in standard military vehicles, driven to its new site and rapidly deployed for action. Now in service with the Army, its inherent mobility allows quick changes of strategy, easy redeployment and provides the versatility which is of ever-increasing importance to present and future air defence.

NEW DEVELOPMENTS

Evolution is going on. Already the successor to Thunderbird has been under development for some considerable time. Employing advanced techniques and retaining its full mobility it will have, among other things, increased low level capability and increased range.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LIMITED *GUIDED WEAPONS DIVISION* · LUTON STEVENAGE · WOOMERA

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

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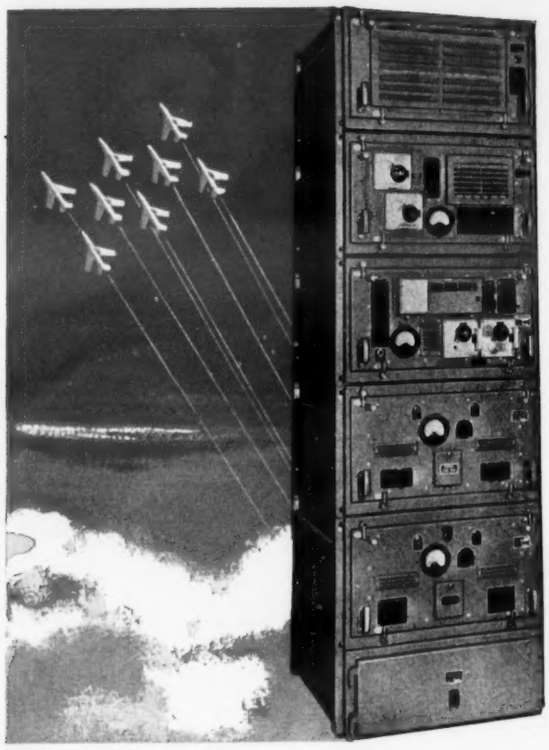
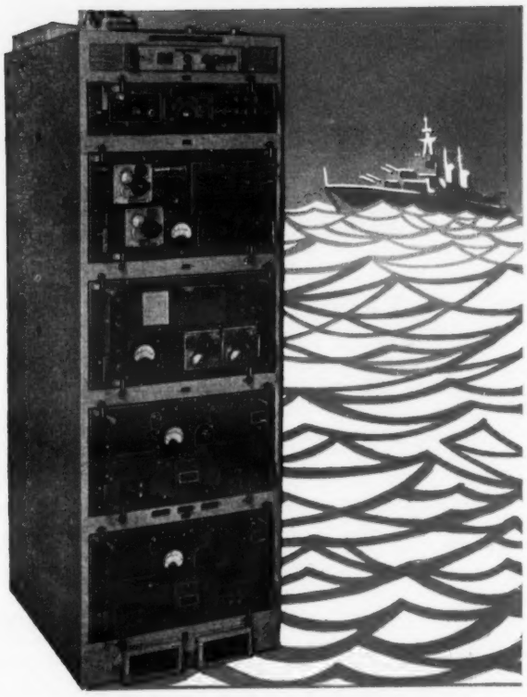
Commanding Voice





Instantaneous, intelligible contact no matter how exacting the conditions—that is the primary requirement of communications in any sphere of offensive or defensive operations.

To meet this need, on the battlefield, in the air and at sea, The Plessey Company, in collaboration with various Government Research and Supply Establishments in Great Britain, has produced a comprehensive range of transmitting and receiving equipment, each specifically designed for its particular application.

For the British and Commonwealth Armies, short-range speech contact to armoured fighting vehicles in the forward areas is maintained with maximum clarity by V.H.F. equipment incorporating revolutionary improvements in electronic and mechanical efficiency. This equipment provides the practical solution to instantaneous communication in mobile warfare.

In meeting the different demands of the air and naval forces, the Company has developed and manufactured Ultra High Frequency equipment, which operates over the whole military UHF band of 225–400 megacycles, providing 1750 as against the existing 560 VHF channels. (A variation is available with 50 Kc/s bandwidth, giving 3500 channels.) Independent of any other form of radio communication activity, it is free from interference and fading and is the most advanced communications equipment of its kind.

For accurate, instantaneous and completely clear communication, the Plessey system of UHF has already been adopted as standard in the Royal Air Force, the Royal Navy, the Navies of the Commonwealth and is also used by the Naval and Air forces of some N.A.T.O. member countries.

The Plessey Company Limited is able to provide these equipments now to authorities in all parts of the world where thoroughly clear and reliable communications are to play a vital role.

PLESSEY INTERNATIONAL LIMITED Plessey **ILFORD · ESSEX · ENGLAND**

Towards the All-Weather Helicopter

The steadily increasing employment of the helicopter in both commercial and military roles has been accompanied by extensive research to improve its capabilities. In comparison with the fixed wing aircraft, the helicopter poses special problems in control and handling. The two following articles describe some of the developments which are at present in hand in the United States to simplify handling and make helicopter operations independent of weather conditions.

The Army-Navy Instrumentation Program (ANIP)

On April 9th, 1953, the Air Branch of the Office of Naval Research and the Systems Presentation Branch of the Bureau of Aeronautics, announced to the aircraft and instrumentation industries a unified research and development programme for the integrated presentation of flight information for fixed wing aircraft. This announcement indicated the appreciation of the U.S. Services for a coordinated approach to the problem of supplying flight information to a pilot in a more easily assimilated form, in order to simplify the handling of modern high performance aircraft, and by doing so, increasing the maximum effectiveness of the pilot-aircraft combination under all environmental conditions. Stemming from this original announcement the programme has both extended and become more detailed as the original philosophy has developed.

In 1954 the U.S. Army joined the project and extended the coverage to include rotary wing aircraft. Since then direction of the research has been controlled by a joint working group composed of the ONR, Bureau of Aeronautics and the Army Signal Corps, and is now known as the Army-Navy Instrumentation Program (ANIP). This working group operates with two mutually complementary teams of industrial organizations as sub-contractors to either Douglas Aircraft Company, the coordinator for fixed wing aircraft, or Bell Helicopter Corporation, the coordinator for the helicopter/VTOL programme.

In passing it is interesting to note that this unified research programme system has now been extended to vehicles other than aircraft. The ONR and Bureau of Ships have since set up similar type organizations to pursue research in both surface and subsurface vessels. The SUBIC (Submarine Integrated Control) programme, with the Electric Boat Division of General Dynamics Corporation as coordinator, is engaged in studies for improving the effectiveness of the submarine man-machine system, while a similar programme SURIC (Surface Integrated Control), coordinated by Sperry Rand Corporation, is designed to advance development in the concepts of surface vessel design and operation.

*

Programme objectives

Before turning to the section of the programme which is related to helicopter operation in particular, it is advisable to consider the basic objectives of ANIP and the philosophy it implies. The first intention is obviously to provide the instrumentation, display and control capabilities which are required to give the operator, in this instance the pilot, or the pilot-aircraft combination, maximum effectiveness under all environmental conditions. From that starting point the intention has been to design a total system which will match the requirements of the man, as distinct from the rather more frequent situation where the man is expected to adapt himself to a variety of preconceived "black boxes" and instruments.

While this is the major objective of the programme, efforts are being directed at the same time to such factors as increased reliability and reductions in size, weight, cost, training time, and maintenance. These objectives are made more easily attainable by the system on which ANIP is based. The coordinator is in the happy position of being able to draw upon the accumulated experience in specialized fields, of the many industrial concerns participating.

Helicopter instrumentation

Before dealing with particular projects which are at present under development for helicopter applications, some consideration should be given to the nature of the problem itself. The helicopter combines at the same time a remarkable range of advantages and disadvantages. As a flying machine it possesses six freedoms of movement and the ability to hover. The space required for landing and take-off is negligible, and once airborne it has a wide range of speeds. Possessing such versatility it is obvious that its field of application is steadily increasing. Against these qualities there are also a number of disadvantages to consider. The helicopter is inherently an unstable machine requiring continuous supervision and control adjustment on the part of the pilot to maintain a desired flight path. For flights of long duration this introduces the question of fatigue far more than in the case of a fixed wing aircraft. This instability also makes instrument flight considerably more difficult, and while some groups will claim all-weather flight capability for the helicopter it is, in fact, non-existent. The succeeding article describing the stabilization system developed by Vertol illustrates the efforts being made to stabilize the in-flight behaviour and to increase the all-weather capability. A similar Auto Stabilization Equipment (ASE) has also been developed by Sikorsky in an attempt to reduce pilot fatigue and give "hands-off" flight stability. These two systems are designed to reduce the load on the pilot, as the first essential in providing the true all-visibility capability required of the modern helicopter.

ANIP approach

Previous attempts to improve all-weather performance have generally taken the form of minor improvements in existing gauges or additional equipment. This method of approach leads to a multiplicity of display gauges which in time of stress are liable to misinterpretation and to an aggravation of the difficulty. A further complication arises from the use of instruments developed for fixed-wing use which do not fully satisfy the needs of rotary wing aircraft.

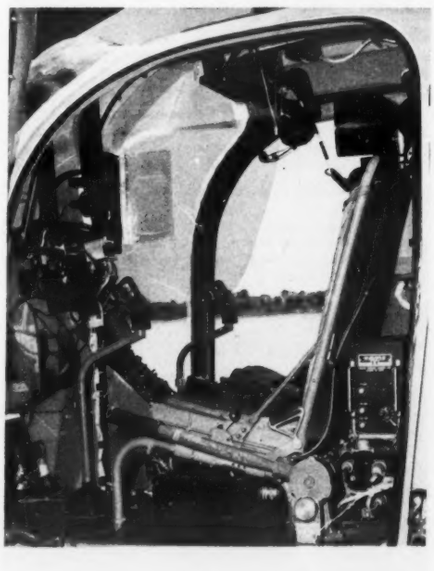
The ANIP concept is devoted to the development of an entirely new system of information display which will both extend the helicopter's flight capability and its field of operations. Apart from the system studies which have been undertaken to establish their feasibility, and the vast amount of laboratory work which has been undertaken either to verify a principle or to provide needed data, some items have progressed to the research application phase. Nineteen major subtask studies have been conducted at Bell's facility and at a local university. These studies were conducted using a small helicopter, a helicopter simulator or other experimental apparatus. The studies have contributed substantially to the establishment of detailed display and control requirements for more complex simulator and flight systems tests.

The recent ANIP symposium organized by the Bell Helicopter Corporation in Dallas, Texas, offers an opportunity of reviewing the progress to date. As prime contractors for the helicopter/VTOL part of the programme, Bell is at present operating two research helicopters and also a helicopter flight simulator designed and built by the Franklin Institute of Philadelphia, to study pilot performance in relation to various display layouts.

The first research helicopter is a Bell HTL-7 which is at present being used to evaluate a Contact Analog system. This display is presented on what appears to be a spherical section of window glass mounted in front of the pilot. The glass is actually a trichroic mirror which reflects a narrow band of light and allows all other colours of the spectrum to pass through. This mirror is part of a projection system built by North American Autonetics. To the pilot the mirror appears transparent except for a green image of the "real-world" representation. This image conveys information to the pilot which enables him to control the aircraft without external reference when clouds or darkness obscure his view. In clear weather the transparency of the mirror permits unobstructed outside vision.

The projected image is a pattern produced by an optomechanical generator which appears as a flat earth plane with a uniform texture, made up of small squares similar to a conventional earth grid. Signals from a Bendix Pacific radar altimeter change the

The cockpit layout of the Bell HTL-7 helicopter used for flight trials of the Contact Analog display. The trichroic mirror is mounted in front of the left-hand seat and the optical projector can be seen above the seat back. Tinted perspex screens the left-hand position to simulate IFR conditions.



A Sikorsky S-58 in "hands-off" flight. The pilot monitors the instruments while the Automatic Stabilization Equipment (ASE) holds the aircraft in hovering flight. Dials on the instrument panel indicate zero speed (top right), altitude 1,500 ft (left centre), and level attitude (top centre).

pattern in altitude, while roll, pitch and heading information is fed in from conventional vertical and directional gyros. Velocity signals are derived from a Ryan doppler radar. The variations in the pattern present an integrated picture to the pilot which continuously shows all these motions in their proper relationship as the helicopter moves through the air. This primary Contact Analog presentation is at present being used to evaluate the performance of non-instrument pilots in its use.

The choice of a projection optical system was dictated by forward thinking on helicopters' operational capabilities. The means employed to display the information to the pilot without impeding his outside vision fall into two categories. Firstly, vacuum type display devices such as flat cathode ray tubes made of transparent materials and secondly, solid state devices. The former system was discarded on the grounds that in low level operations the possibility of small arms fire introduced an unacceptable implosion hazard in the cockpit. In consequence the solid mirror and projector system was adopted to reduce operational risk.

*

The second research aircraft used in the programme is a larger Bell helicopter (Army HU-1A or *Iroquois*). Development apparatus which has been installed or will be installed on this vehicle includes an electronic control system with various modes of stabilization (designed and built by Bell); an airborne radar (built by Bendix Pacific) which will present radar mapping information and forward looking obstacle information, and a radar data converter (developed by DuMont Laboratories). The radar data converter is designed to accept the radar obstacle information and convert it for visual display on a television monitor. The range proximity of obstacles is indicated by the display intensity, distant ones being less bright than the more immediate ones. It is anticipated that in future developments the obstacle information will be included in the Contact Analog display.

A future installation in this helicopter will be the airborne Central Control Computer (developed by Litton Industries). This computer together with the appropriate subsystem sensors will perform computations relative to navigation, safety of flight and fuel management. Results of these computations will be displayed on simplified instruments within the cockpit.

*

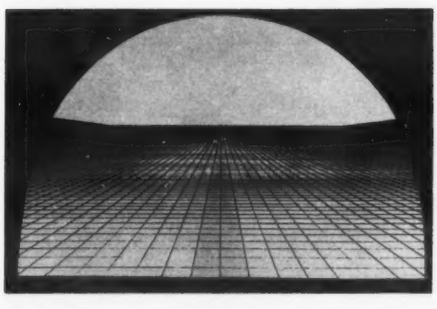
A simulator developed by the Franklin Institute and known as the Helicopter Flight Simulator Dynamic Platform, is also being used to supplement the research flying in the actual aircraft. The simulator carries a full-sized helicopter cockpit and is capable of reproducing all the accelerations to which a helicopter is subjected in the air. Besides being capable of pitch, roll and yaw movements, the platform can rise eight feet and also move sideways and fore-and-aft. The main function of the simulator is to aid in Human Factors engineering problems by simplifying the study of pilot performance in the display-control-performance chain. In order to introduce the greatest degree of realism and to measure the influence of distracting effects similar to real helicopter flight, rough air conditions can be introduced together with engine and rotor noise and cabin vibrations.

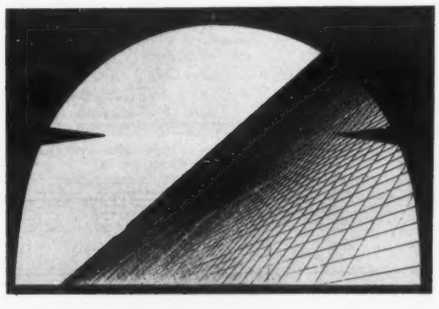
Developments to date

The main direction which the ANIP programme is taking can be summarized briefly as follows: Research and development in methods of contact analog presentation with the next stage being the introduction of a direction system into the display which will indicate the course to follow to the pilot; radar sensing of obstacle information and integration of the information on the display for terrain avoidance; and the development of flight safety and navigation instrumentation from a computer source. Other developments in hand include a micro wave remote area instrument landing system (MWRAILS) which enables pilots with a minimum of instrument flight experience to make instrument landings and take-offs into known, remote, confined areas. This portable landing aid provides the four essential items of information for remote area operations. These are absolute altitude, ground speed, precise location of the desired landing point and approach path information. The system uses a servo-positioned radar antenna which supplies the appropriate information to the airborne situation computer and in turn to the display. Another step in helicopter instrumentation is the air velocity sensor which has been developed to overcome the difficulty of measuring air speeds below 20 m.p.h. A conventional type of airspeed measuring device mounted on the fuselage of a helicopter is subject to effects from the rotor turbulence, which introduces inaccuracies. Since the basic information required is the relative motion of the helicopter in relation to the undisturbed air mass surrounding it, a new approach to the problem has been necessary. An acoustic source located between the transmitting and receiving antenna of a doppler radar projects a sound wave out beyond the turbulent air mass. An electromagnetic (radar) beam transmitted by the doppler is reflected by the sound wave, and the frequency of the return can be interpreted in terms of airspeed. The system has been developed by the Midwest Research Institute and represents a major advance in speed sensing methods.

The advances made in helicopter instrumentation under the ANIP programme are paralleled in the fixed wing aircraft field. The enormous potential of the helicopter, however, both in military and civilian applications, will only be fully developed when the physical restrictions of human performance are overcome. ANIP points to the future when its all-visibility capability will be a commonplace.

The two diagrams show the appearance of the contact analog pattern as it is projected on the mirror. On the left the pattern indicates the helicopter in straight and level flight. The right-hand pattern indicates a descending right-hand turn. The altered alignment of the grid shows the aircraft's change of direction; the two triangular indices on the display indicate the position of the normal horizon.





Helicopter S

Vertol is now equipping all of its new helicopters with a *Stability Augmentation System (SAS)* to provide flying qualities equivalent to that of a fixed wing aircraft. With an SAS-equipped helicopter it is now possible to fly "hands-off" for several minutes at a time and to make well coordinated "stick" turns over a wide range of forward speed.

*

The Vertol SAS system consists essentially of a sensor in each axis to detect helicopter motion and feed a corrective signal into the control system.

The signals from the sensor are fed into the control system differentially, i. e. the controls at the rotor heads are moved without any motion of the pilot's controls. This system offers two basic advantages. First, it eliminates undesirable forces and motions from the pilot's control and second, it permits the use of limited authority so that the SAS can never move the controls by more than 25% of their total travel. This has been found to be ample for stabilization purposes and it means that even in the event of a malfunction resulting in a hard-over signal, there would be no large sudden motions of the aircraft, and the pilot can easily override the SAS. In addition, the control system stops are arranged on the output side of the SAS actuators so that in the event of a hard-over signal the pilot still has available his normal full control plus a sufficient over-travel to counteract the full SAS signal.

The present SAS was developed following an extensive analytical and flight test program. Various possible means of improving stability were first investigated on an analog computer, and the most promising systems from this analysis were then tested in an HUP-4. Displacement, rate and acceleration and sideslip were all considered as possible parameters for sensing, and any combination of these could be fed into any axis or axes with or without a time lag. Eight of these systems were actually flight tested in the HUP. By installing a multiplicity of sensing devices and providing suitable rapid switching and in-flight adjustment of gain settings, it was possible to obtain a direct comparison of the stabilizing characteristics of these various systems.

The system finally selected for the HUP-4 uses a lagged pitch rate damper in the longitudinal system, a roll rate damper without lag in the lateral system, and a yaw rate damper in the directional system. In addition, roll rate may also be fed into the yaw axis to improve spiral divergence; and lateral stick displacement may also be added into the yaw axis in order to provide apparent static directional stability. During the course of the HUP flight test program, the aircraft was frequently flown hands-off for periods of four to five minutes. In addition, the helicopter successfully flew for two minutes hands-off in a steady partial power descent at 750 feet/min at 30 knots airspeed, as would be required for blind

Stabilization

By Norman C. Taylor,
Chief Engineer, Vertol Aircraft Corporation,
Morton, Pennsylvania

Fig. 1: The Vertol 107 fitted with the stabilization system. The arrows indicate the position of the two static pressure ports which transmit information to the sensing units.

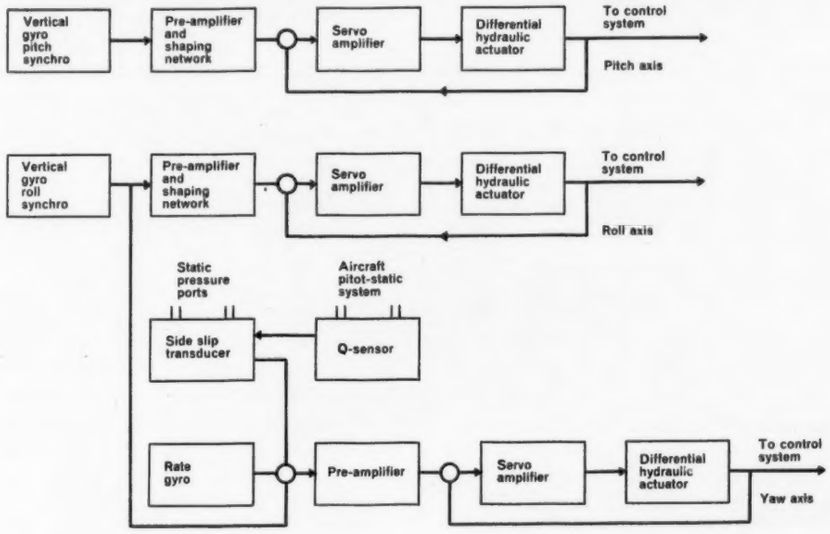


Fig. 2: A schematic diagram of the three sections of the system. The upper line illustrates the pitch axis control derived from a vertical gyro; the interconnected roll and yaw axis controls are influenced by signals from the pitot-static system.

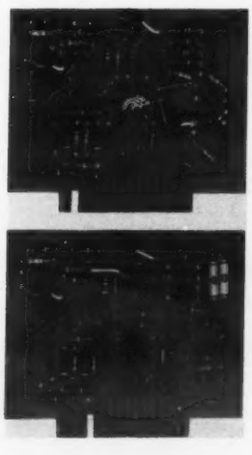


Fig. 3 and 4: A view of the equipment test panel and printed circuit boards used in the installation.

approaches. This test was limited to two minutes by lack of altitude alone, and the stability would have been adequate to continue for a substantially longer period.

Initial tests of the HUP-4 system on the Vertol Model 107 revealed a requirement for more stability in the yaw axis than that which is obtained without the addition of a sideslip sensor. To avoid the installation of a boom in front of the aircraft for mounting a sideslip vane, a system was developed which sensed sideslip using a differential pressure transducer fed from a pair of static ports symmetrically disposed on the front of the forward pylon.

*

The electronic system is contained in a single "black box." The only other elements of the system are the three hydraulic actuators, one for each control axis, and a vertical gyro which is already a part of the aircraft instrumentation system. Both the electronic system and the hydraulic actuators are Vertol designed and manufactured. This is the result of a recent Vertol policy to expand both its engineering and its manufacturing capability in the electronic and the hydraulic field. The SAS system was chosen as an initial undertaking since it is so intimately associated with so many of the helicopter systems (viz. aerodynamics, dynamics, control, electrical, instrumentation, hydraulic) that it requires custom design. The design features (a) transistor and magnetic amplifiers for extreme reliability; (b) light weight of 6.5 lb for the electronic unit; (c) plug-in printed wiring amplifier boards *(Fig. 3)* for quick easy maintenance and (d) self checking with a self contained voltmeter.

Figure 2 is a block diagram of the Vertol SAS. The magnetic servo amplifier and the hydraulic actuator are identical for pitch, roll and yaw. The sensor for both pitch and roll is the vertical gyro already part of the aircraft. For the roll axis, rate is electronically derived from the gyro attitude signal. For the pitch axis the rate is also derived but is also electronically "lagged" as required by helicopter dynamics. The signals into the yaw axis are yaw rate from a rate gyro contained within the electronic unit, bank angle from the vertical gyro and a signal proportional to sideslip. The sideslip signal is obtained from a differential pressure transducer within the unit. The transducer is fed from a pair of symmetrically located static ports on the front of the aircraft *(Fig. 1)*. A second identical transducer measures air speed from the aircraft's pitot-static system and varies the gain of the sideslip transducer to maintain optimum stability at all air speeds.

*

The Vertol SAS has received enthusiastic acceptance from all pilots who have flown the system. The use of differential actuators provides stability without any unusual motion or forces in the helicopter control system. Except for a marked increase in the helicopter stability, the pilot is not aware of the operation of the system. Compared with a typical autopilot, which supplies complete stability at the expense of controllability, the SAS allows normal control and maneuvering with only a small sacrifice in stability.

Vertol is now developing an autopilot which will, rather than replace the SAS, work in conjunction with it. During maneuver, the handling characteristics of SAS will be maintained. For complete hands-off flight, attitude stabilization will be provided, as will a fourth axis for altitude stabliziation.

The R.A.F. Search and Rescue Service in 1959

An Air Ministry report

The winch double-hoist rescue being demonstrated by the crew of a Bristol *Sycamore*. The crewman is lowered to the casualty by line; rescuer and rescued are then hoisted to the helicopter together.

While Britain's phenomenal summer has meant unrivalled holidays beside the sea, it has brought for R.A.F. Coastal Command's search and rescue organization the busiest season ever.

Whirlwind and *Sycamore* helicopters of the two R.A.F. search and rescue squadrons, whose detachments are deployed around Britain either on or near the coast, dealt with 241 rescue incidents between January 1st and the official end of summer on September 21st, of which all but 16 incidents occurred during the summer months.

Of the total, 173 incidents involved boating, bathing and other close-to-shore mishaps, and in every case concerned civilians, of whom 35 were either rescued from the sea or assisted to safety from precarious positions on the shore. Although the R.A.F. search and rescue organization primarily exists to assist in Service incidents, nearly all the missions on which R.A.F. helicopters took off this year concerned civilians in trouble. Helicopters were called out on 50 false alarms, each of which, however, had to be investigated.

Although R.A.F. marine craft, whose work during the war saved thousands of lives throughout the world, are no longer established for search and rescue work in Britain, having given way to the helicopter, those still operating dealt with 24 incidents, 12 involving civilians, of whom eight were rescued and three more otherwise assisted.

Altogether, the *Whirlwind* helicopters of No. 22 Squadron, and the *Sycamores* of No. 228 Squadron (until recently known as No. 275 Squadron), flew 132 hours on mercy work in the first 8½ months of 1959. Ambulance work carried out by them involved 44 cases of seriously ill or injured civilians being flown to hospitals in various parts of the country, such missions frequently calling for close cooperation between the helicopters, ordinary aircraft, and civil or Service motor ambulances.

R.A.F. helicopters went to the help of many children in bathing, boating and other difficulties. Among the 50 false alarms which brought the helicopters from their dawn-to-dusk standby posts, were two in which bathers were reported in trouble. On arriving at the scenes the helicopter crews found that the "bathers" were a beach ball and a plank with two bushes fixed to it drifting out to sea.

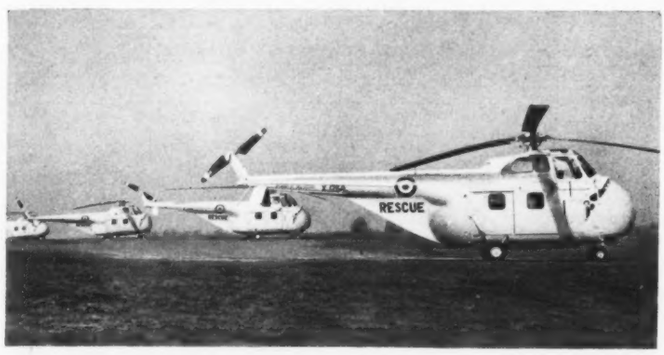
All helicopter rescues effected were by the winch double-hoist method, whereby the winchman is lowered to the victim by line, wraps a harness around him and supports him while rescuer and rescued are winched up together into the helicopter.

R.A.F. search and rescue helicopters are permanently stationed at Leuchars (Fife), Acklington (Northumberland), Horsham St. Faith (Norfolk), Felixstowe (Suffolk), Thorney Island (Hants.), Chivenor (Devon), Valley (Anglesey), Leconfield (Yorks.), and St. Mawgan (Cornwall).

An outline map of the British Isles showing the permanent location of the rescue detachments.

1. Leuchars
2. Acklington
3. Leconfield
4. Horsham St. Faith
5. Felixstowe
6. Thorney Island
7. Chivenor
8. St. Mawgan
9. Valley

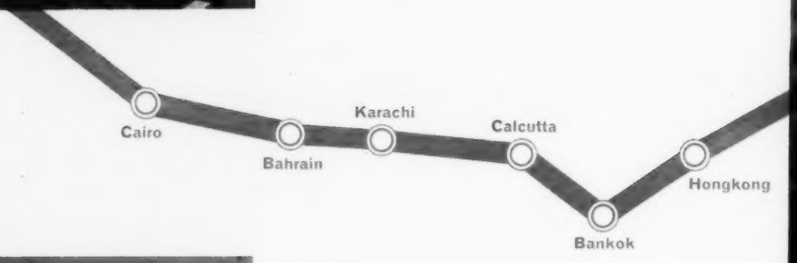
Westland *Whirlwind* helicopters in the colours of the R.A.F. Rescue Service seen at the manufacturer's airfield awaiting delivery to the Squadrons.



London as the helicopter sees it. Trafalgar Square, with Nelson's Column in the centre of the picture and behind it the Admiralty Arch from which The Mall (top right) leads straight to Buckingham Palace. The church in the foreground is St. Martin-in-the-Fields, and the domed building to its right, facing the Square, the National Gallery. The road leading to the left-hand top corner of the picture is Whitehall, and the two buildings facing the short sides of the Square are South Africa House on the left and Canada House on the right. Trafalgar Square was laid out in 1829-1841 as a memorial to Nelson. *Courtesy Photoflight, London.*

Far East Assignment

Snapshots and Impressions by K. Regelin, Interavia, Geneva



The Alps from 16,000 feet.

Smoothly the Swissair DC-6B glides through the starry Mediterranean night. Cairo, the eternal city of the Nile and capital of the new United Arab Republic, is sunk in sleep as passengers drift yawning into the transit lounge. Our attention is caught by the red and yellow wall posters proclaiming the future of the Arab world, but we have barely begun to decipher them when the loudspeaker calls us back to the aircraft. Good old Europe is far behind us. Gradually the Arabian peninsula swims out of the darkness, in the first rays of the rising sun, and soon the sandy islands of Bahrain take shape in the blue-green waters of the Persian Gulf. Nothing stirs on the former RAF World War II base. Apart from the airlines which call here to refuel for the trip across the Arabian Sea, nothing disturbs the peace of the small group of islands and its pearl fishers. The oil continues to flow noiselessly into the waiting tankers. As the stewardess comes round with hot towels and champagne to refresh her perspiring passengers, I study the menu. What succulent meals the airlines have devised to occupy their passengers on the two-day flight to Japan! Breakfast disposes of one hour; lunch is *à la carte;* dinner, with caviar, crème mulligatawny, suprême de Bresse and the choicest wines and liqueurs, takes up a good two hours; and so on. Between meals a smiling stewardess appears with drinks . . . "another Bloody Mary?" (vodka has meanwhile also found its way into aircraft bars).

Soon we are landing at Karachi, where the runway extension is almost completed. Two Qantas Boeing 707s take off within ten minutes of each other for route proving flights to Australia. With its modern terminal buildings and ground installations, this airport now appears to be fully equipped for international jet traffic. A few hours further on, India, the

Passenger block at Bahrain airport: luxury atmosphere with Coca-Cola and ceiling fan.

Terminal building and control tower at Karachi International airport.

Servicing the DC-6B at 105° in the shade. At all stops on the Far East route the passenger cabin is immediately connected to a mobile ventilation and air-conditioning system.

Modern architecture and attractive layout of the airport buildings at Bangkok reveal that the Siamese authorities recognize the importance of their capital in the Far East air transport structure.

After a day and a half of flight our HB-IBU submits to an inspection of the pressurization system on Bangkok's monsoon-drenched apron.

The new runway at Hong Kong's Kai Tak International Airport, 8,000 feet in length, is built on a stone embankment stretching out like a narrow finger into the harbour. In the rear is a Canadian Pacific Air Lines *Britannia*.

The approach to the British Crown Colony of Hong Kong offers a fascinating picture. Clustered cheek by jowl along Hong Kong Bay, and embedded among olive green hills, are skyscrapers, giant hotels, luxury homes and the most miserable of hovels. The waters of the bay are alive with junks, lighters and cargo boats. And above all stretches the brilliant blue sky, marked on the horizon by condensation trails from Red Chinese MiG fighters.

steaming southern tip of Asia, awaits our arrival. Leaving Calcutta, we push on to Bangkok and Hong Kong . . . Gradually Asia changes its aspect, but it is not until the British Crown Colony is reached that the contrasts between East and West come sharply into focus.

The big airlines are engaged in hard competition on this Far East route. European, American and Asian companies vie with each other—by all fair means—for the custom of the air traveller. But the busy scene on the airports of the Middle and Far East is dominated by Arabs, Indians, Siamese, Indonesians and Japanese, not Americans or Europeans. Asia has discovered air transport, and its airlines are members of the world air transport family. It is certainly not by mere chance that the IATA Annual General Meeting has now been held in the East for two years in succession. Talking of IATA . . . A newspaper I was reading shortly before arriving at Tokyo carried a headline "The Crisis in World Air Transport." Our DC-6B has been well filled right along the route (though most passengers travelled with us on only two or three stages, and few have flown the whole distance). The Mumm Brut Cordon Rouge champagne is excellent, and there is no visible sign here of crisis in air transportation.

Now we turn the next page of our Far East travelogue; below us are the lights of Tokyo, ahead the 15th IATA Annual General Meeting.

Midnight on the Ginza, Tokyo's business thoroughfare in the heart of the Japanese capital.

Tokyo, Temples and Tariffs

Sir William Hildred at the opening of the 15th IATA Annual General Meeting in the Peacock Room of the Imperial Hotel, Tokyo. To the right, the new President of IATA, Seijiro Yanagita (JAL) and Japanese Transport Minister Wataru Narahashi, to the left Japanese Deputy Prime Minister Shuji Masutani and Dr. Ryutaro Azuma, Mayor of Tokyo.

The Mayor of Tokyo holds a reception in the Tokyo Kaikan.

Headaches at the 15th IATA Annual General Meeting

If—*ex oriente lux*—light had really come from the East, things would have been a lot easier for IATA . . .

When Japanese Premier Nobusuke Kishi opened this year's Annual General Meeting of the International Air Transport Association in Tokyo's Imperial Hotel on October 12th, many of the 150 delegates were in spirit at another conference on the Hawaiian island of Oahu. While Mr. Kishi expressed his conviction that jet traffic would bring the peoples of the earth together for the common good, the IATA Conference in Honolulu was struggling to find a compromise which would end the months-old deadlock over the key question of the jet age: the establishment of air fares on a world-wide basis. Since the adjournment of the last Traffic Conference in Cannes in April this year the readjustment of air rates and fares has been IATA's chief preoccupation.

Today it is known that Honolulu did *not* bring the long-awaited agreement (cf. *Interavia* Review No. 11/59, page 1341), and that not even the airline chiefs assembled in Tokyo could find a practical way out of the dilemma. When they left the Japanese capital all that remained was the silent hope that everything would turn out all right after March 31st, 1960, when companies will take their own initiative in negotiating fares. It is true that fares on many stages will remain virtually unchanged, but there are plenty of unknown factors which make a reliable forecast for the near future impossible. At a time when the air transport industry, faced with the conversion to jet operation, is beset with countless hazards, the IATA companies must prepare for keener competition with open minimum fares on almost all the world's main air routes.

*

With this somewhat discouraging prospect hospitable Japan bade her guests from IATA good-bye—though not before the committees had wrestled over numberless technical questions and found many workable compromises. That the work of the specialized committees now and then encountered difficulties, was due not only to the complexity of the points of detail under discussion, but also to the ever-increasing number of member companies which expect IATA to give their special wishes and interests full consideration. For a record number of 80 active and 10 associate members from a total 50 States were represented at this year's IATA Annual General Meeting. Although no universally acceptable solution was reached in the decisive matter of fares, IATA can nevertheless look back on a year of hard and successful work, as witness the annual report of the Director General (cf. *Interavia* Review No. 11/59, page 1398) and the reports of the specialized committees.

Under the skilful chairmanship of Japan Air Lines President Seijiro Yanagita, the Executive Committee again met *in camera* to discuss the lines along which future work was to proceed. Meanwhile, delegates to the specialized committees deliberated on technical, financial and operational problems.

The *Financial Committee* sounded a warning note, stressing that increased landing fees, charges for the use of navigational facilities, and sundry taxes would nullify the companies' efforts to lower air fares. The Committee's Chairman, K. W. Bevan, of BOAC, said that the airlines were not seeking to escape taxes and charges, but merely urging the authorities to adopt a rational taxation policy. The Committee's report emphatically rejected proposals for the inclusion of airport passenger service charges in air ticket prices. Passengers would lay the blame for the resulting higher fares on the very airlines which were battling with might and main to have them reduced. Bevan then pointed out that the clearance turnover from interline agreements had risen by 28 percent in the financial year 1958, and again stressed the importance of the IATA Clearing House in London. In 1958 clearance turnover had reached the impressive sum of $821,000,000, but the figure expected for 1959 was of the order of $1,000 million.

The *Technical Committee's* Report dealt, *inter alia*, with military restrictions on the use of airspace over the North Atlantic and the Pacific, where prohibited areas considerably hampered the movements of the new jet services. In Europe negotiations with the military authorities had resulted in the opening of new airlanes for high-altitude flight, and an international air traffic control system, Eurocontrol, was to be created; similar arrangements should be made for the other air traffic regions. In connection with this year's IATA Technical Conference in Berkeley, California, the airlines already experienced in jet operations had organized a "Symposium of Jet Operating Experience." This recommended that more care than hitherto be devoted to the training of jet pilots by instructors "who have themselves been given the most thorough training possible." As costs amounted to about $2,000 per flying hour, training should be planned with care, and courses should, as far as possible, be uninterrupted. The proper use of flight simulators could save a pilot four or five hours, i. e. about 25 percent of total flight training time.

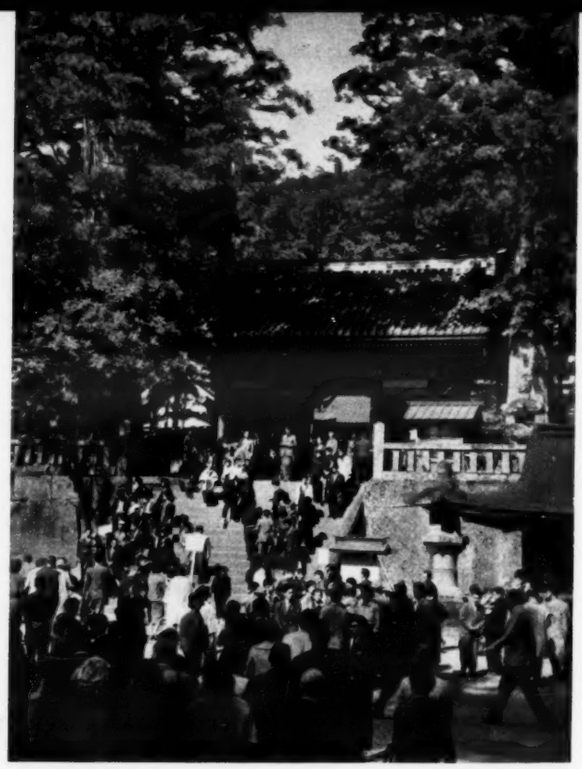
On behalf of the *Facilitation Advisory Group* IATA Director General Sir William Hildred spoke out vigorously against red tape. Jet aircraft required considerably faster ground handling than at present; above all, official handling formalities must be speeded and simplified. The same applied to freight services. Today freight can be flown from the USA to Tokyo in 12 to 24 hours, but the importer must wait anything from three

days to a week until his consignment has been channelled through all the official controls. The visas still demanded by the Japanese authorities were adversely affecting the Government's efforts to stimulate the tourist trade. The Report of the Executive Committee, too, drew attention to the crying need for quicker ground handling and simplified formalities, and singled out the Pacific region as being particularly in want of reform.

In the light of the most recent developments in the fares situation the *Executive Committee* found itself obliged, after intense soul-searching, to maintain the ruling that all IATA resolutions and decisions will, in future as hitherto, require unanimous agreement. The Committee did, however,

Guests of honour of the Mayor of Tokyo (second from left): the present IATA President, Seijiro Yanagita (right) and Mrs. Yanagita, and the next President, Åke Rusck.

Hosts of the 15th Annual General Meeting: Prime Minister Nobusuke Kishi (left), IATA and Japan Air Lines President S. Yanagita and JAL Senior Vice-President S. Matsuo.



Entrance to the Toshogu Temple.

for the first time consider giving separate eligibility to vote on cargo and passenger resolutions. Finally, on the day before the Conference ended, three new members were elected to the 18-man Executive Committee: Charles A. Beard (President, Braniff International Airways) in succession to Croil Hunter (Chairman, Northwest Orient Airlines); Max Hymans (President, Air France) in place of Air France's General Manager René Briend, who, as one of the founders of the old IATA, has seen more than ten years of successful activity on the Executive Committee of the new organization; J. G. Grove (Chief Executive, South African Airways) in succession to D. M. Robbertze of the same company.

The final session, at which all delegates were present, approved the IATA budget for 1960, which provides for receipts of $1,087,400 and expenses of $1,403,800; the Organization will thus have to draw on its Surplus to the tune of $316,400. After approving annual membership dues ($500 for associate members, and a fixed levy of $1,000 plus a variable levy in relation to revenue tonne-kilometre performed for active members), the plenary session confirmed the Executive Committee's appointments of new members to the Financial Committee, the Legal Committee, the Technical Committee, the Traffic Advisory Committee and the Medical Committee.

Perhaps the social climate of the IATA excursion to Nikko National Park will have given delegates the opportunity to start personal discussions towards the solution of their problems. Many will have recalled the saying quoted by IATA President Yanagita, which has inspired the Japanese for the past fourteen hundred years: "Wa wo motte tutoshi to nasu"—"What you accomplish will be achieved through agreement." The rocky splendour of the mountain lake of Chuzenji and the noble calm of the Toshogu Temple may have helped these pilgrims of the jet age to forget their workaday worries and to ponder the serene wisdom of these words.

The week of meetings came to a brilliant end with a shipboard party given by the leading manufacturers of transport aircraft on the *Koan Maru*, anchored in Tokyo harbour. *Kabuki* drama, traditional tea ceremonies, *Koto* music and puppet plays, *tempura*, *yakitori* and warm *sake*, almost made the IATA delegates forget why they had originally come to the Land of the Rising Sun.

If the delegates to this year's IATA Annual General Meeting left for the East with high hopes, they will meet next year on European soil with somewhat more modest expectations. On behalf of his company and the Danish Government Åke Rusck, of SAS, as next President of IATA, has invited the Meeting to Copenhagen for September 12th, 1960. Jet transport will by then have got over its teething troubles, and all companies operating jet aircraft will have enough practical experience to make the revision of air fares possible. The Annual General Meeting at Copenhagen will be preceded by a new Traffic Conference, and it is to be hoped, in the interests of the entire air transport industry, that agreement will be reached before the Copenhagen Meeting. It remains to be seen what can meanwhile be done for jet transport at government level.

1 2 3 4 5 6

1. Sir William preoccupied with sandwiches and tariffs. 2. KLM President I. A. Aler. 3. Swissair President W. Berchtold (left) in conversation with L. H. Slotemaker of KLM. 4. Mrs. Tata, wife of last year's IATA President. 5. Air India International Vice-Chairman B. R. Patel with daughter (far left), geisha and JAL hostess. 6. *Samurai* as temple guardians.

An Old Industry
Makes a New Start

Japan's Aircraft and Engine Manufacturers

Marunouchi, Tokyo's ultra-modern business district, houses the head offices of all the major Japanese industrial companies concerned with aircraft manufacture.

When, in April, 1952, the Treaty of San Francisco restored Japan's air sovereignty and with it the right to manufacture aviation products, nobody dared forecast the future of this branch of an industry which had originally devoted itself entirely to military production. Today, seven and a half years after this second start, a new industry has grown up, which, though modest by comparison with its wartime peak period, has overcome its initial difficulties and seems to be working in the right direction. Whereas during World War II the Japanese aircraft and engine industry employed about a million workers and produced 100,000 aircraft (of which 28,220 were rolled out in 1944 alone), the number of employees is today barely 17,000 and total post-war production runs to 650 aircraft.

As, however, firms were forced to start again from scratch, since the old installations were for the most part destroyed or dismantled, they bought modern machinery and facilities. Their manufacturing operations were rationalized and brought to a relatively high degree of productivity – at low capital investment – by repair and maintenance contracts from the U.S. Forces. Even more important was the technical knowledge acquired from the West after a long interval of enforced inactivity, knowledge which was extended by the licence agreements later signed with American firms.

Firstly, trainers and fighters . . .

With the reconstitution of the Japanese armed forces there came a sudden requirement for trainers and fighters in large enough numbers for the quantity production of standard types under licence, and even the independent development of a few new models.

Since August 1955 *Fuji Heavy Industries Ltd.* (formerly Nakajima Aircraft) has built 75 Beechcraft T-34 *Mentor* basic trainers, having previously assembled and test-flown 49 of these aircraft. In addition, the Cessna L-19 communications aircraft has been built under licence for the Ground Self Defense Force, and a large number of the U.S. Army's L-19s have been overhauled and maintained. Fuji is now working on a Philippine Air Force contract for 36 *Mentors* as war reparations. In March this year *Kawasaki Aircraft Co.* completed licence manufacture of 210 Lockheed T-33A jet trainers, 60 percent of whose components and equipment were being built in Japan by the time the series was completed. Production was financed by Japanese and American money under a defence aid agreement between the two countries. Under a similar agreement *Mitsubishi Heavy-Industries Reorganized Ltd.* is building 300 North American F-86F jet fighters for final delivery by March 1960.

In addition, Fuji has developed a two-seat jet trainer of its own, the T1F2, whose prototype has for the past year been undergoing thorough testing in the hands of military pilots. After delivery of a total six pre-production models (including prototypes), about 100 Fuji jet trainers are to be manufactured as replacements for the North American T-6Gs supplied by the USAF. Licence manufacture by Kawasaki of the 35-ton Lockheed P2V-7 anti-submarine aircraft, which has already begun, and the planned production of about 200 Lockheed F-104CJ supersonic fighters, show the military trend in current Japanese aircraft production, whose total turnover value has so far reached 41,200 million yen (U.S. $114 million). Of this figure, 65 percent is accounted for by supplies to the Japanese forces, 25 percent by repair and maintenance contracts for the U.S. forces in Japan, and only 10 percent by civil domestic and export sales and service (maintenance of commercial aircraft etc.), and reparations deliveries.

Faced with this unhealthy relationship and the gradual withdrawal of American forces from Japan, manufacturers understandably looked for something to counterbalance their predominantly military production programmes, and it was recognized that the opening of new civil markets would be vital to the survival of the industry. Where, however, could such markets be found, and with what products could they be conquered?

. . . then a transport aircraft

Soon the leading aircraft manufacturers agreed that a medium-sized commercial turboprop aircraft—such as, for instance, a replacement for the DC-3 or DC-4—could be manufactured at a competitive price due to the low wages in the Japanese industry. This would represent their last chance on the export market—in South-East Asia and South America, at least. At the beginning of 1957, following proposals by the Ministry of International Trade and Industry, six large and twelve smaller Japanese firms set to work on a joint project. The six large concerns were: Fuji Heavy Industries; Japan Aircraft Manufacturing Co.; Kawasaki Aircraft; Mitsubishi Heavy-Industries Reorganized; Shin Meiwa Industry Co. and Showa Aircraft Industry Co.

In the same year these companies formed a consortium, the Transport Aircraft Development Association (TADA), to lay down specifications for the aircraft, decide on the most important features of its design and build a complete full-sized mock-up. The specifications were for a twin-engined aircraft with a wing span of 107 feet, a take-off weight of roughly

The Nihon Aeroplane Manufacturing Co., a group of six leading Japanese aircraft producers, is developing and building the YS-11 twin-engine turboprop transport (two Rolls-Royce Dart RDa.10s*), in which All-Nippon Airways, the Japanese Defense Agency and several non-Japanese airlines are interested.*

48,500 lb, a cruising speed of 265 knots and a range of 550 nautical miles carrying 60 passengers. The mock-up of the transport aircraft, designated YS-11, was built at Japan Aircraft Manufacturing Co.'s Sugita Works and completed in December, 1958. Since then certain modifications have been made, which have been incorporated in a second fuselage mock-up. In the middle of this year there arose out of TADA a new company with Government financial backing, the *Nihon Aeroplane Manufacturing Company* (NAMC), which is now responsible for building the prototype of the YS-11 and manufacturing it in quantity.

Taizo Shoda, head of the old TADA and formerly Vice-President of Mitsubishi, is President of NAMC, whose board consists of Government representatives and directors of the "big three"—Fuji, Kawasaki and Mitsubishi. Under NAMC's five-year plan the first prototype of the YS-11 should be ready for flight testing in 1961, the second at the beginning of 1962. The first production aircraft would be rolled out in the second half of 1963. It is hoped that there will soon be an opportunity to give a more detailed report on this transport aircraft, which will be powered by two Rolls-Royce *Dart RDa.10s*.

The large airframe manufacturers

Under the Aircraft Manufacturing Law sixteen firms are authorized to build and repair complete aircraft and specialized equipment. A further 40 companies are licensed to manufacture and repair airborne and ground equipment in general. That the Japanese aircraft industry is keeping within modest limits is shown by the following figures: The total area of the manufacturing facilities of the 25 largest concerns is about 5,500,000 sq.ft., and their capital investments add up to 12,000 million yen ($33,5 million). The

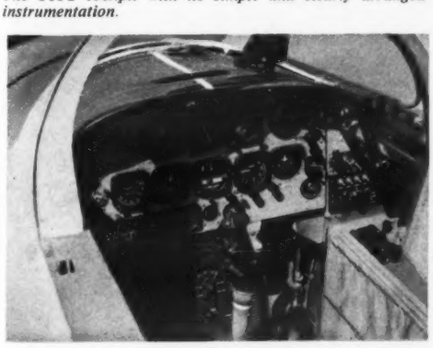
The Fuji T1F2 two-seat jet trainer (Bristol Orpheus BOr.1*) is being flight tested by test pilots from the Defense Agency and is to be produced in considerable numbers (more than 100 aircraft) for the Japanese Air Self Defense Force.*

The works airfield of Fuji's Utsunomiya Division; Cessna L-19s built under licence and overhauled for the U.S. Army (right), also a number of licence-built Beech/Fuji T-34 Mentors *for the Japanese and Philippine air forces.*

Fuji's export hope: the KM-1 Super Nikko *four-seat touring aircraft (340 h.p. Lycoming GSO-480). Ready for a demonstration flight, right to left; T. Itoh (*Interavia *office, Japan), K. Nakamura (Manager of the Scamp Department at Fuji's Utsunomiya Division), Fuji chief pilot for the KM programme, and the writer.*

The Fuji T1F2 jet trainer is prepared for take-off.

The T1F2 cockpit with its simple and clearly arranged instrumentation.



Final assembly of the T1F2 jet trainer at Fuji's Utsunomiya plant. In the rear is a fully assembled LM-1 Nikko.

Kawasaki has begun licence production of the Lockheed P2V-7 Neptune *anti-submarine aircraft for the Japanese Navy.*

Kawasaki KAT-1 two-seat elementary trainer (240 h.p. Lycoming GO-435).

Lockheed/Kawasaki T-33A jet trainer: licence production was concluded a few months ago with the delivery of the 210th aircraft.

Kawasaki KAL-2 communications and touring four-seater (240 h.p. Lycoming GO-435).

largest share of this sum is accounted for by a few firms which are subsidiaries or divisions of Japan's mighty heavy industries and which have been built up cautiously without attempting to seek prestige. In this connection four firms, in particular, should be mentioned: Fuji, Kawasaki, Mitsubishi and Shin Meiwa. All of these companies, with the exception of the last, are concerned with the overhaul of aircraft engines, the production of equipment and the development of guided missiles.

Fuji Heavy Industries Ltd. concentrates its activities in the aircraft sector at the Utsunomiya facility, where hundreds of fighters and torpedo bombers were rolled off the assembly lines each month during the last war. In addition to the licence manufacture of the Beech T-34 *Mentor* already mentioned, Fuji is producing and developing the LM-1 *Nikko* and the KM-1 *Super Nikko* four-seat touring and communications aircraft, which are robust multipurpose low-wing models derived from the *Mentor* and capable of performing a variety of tasks in air work. Under an offshore contract the USA ordered 27 *Nikkos* for the Japanese Ground Self Defense Force; delivery of these is now complete. The works management places particularly high export hopes in the *Super Nikko* (340 h.p. Lycoming engine), whose reinforced airframe and complete radio navigation equipment should make it one of the most efficient aircraft in its weight class.

The development programme for the Bristol *Orpheus BOr.1* powered T1F2 jet trainer is continuing, and an order for a first batch of 20 is expected by the end of the year. Fuji has also received a 25 million yen contract from the Defense Agency for the conversion of a T1F2 into a research aircraft for high lift studies (boundary layer control).

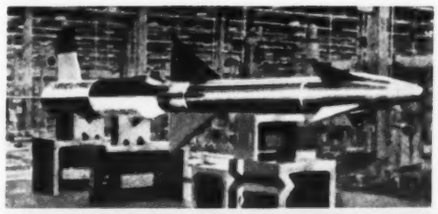
Kawasaki Aircraft Co. Ltd., one of the oldest and largest aircraft works in Japan, again employs more than 6,000 personnel at its two main facilities in Kobe and Gifu. Now that T-33A production is completed, the Gifu facility is concentrating on licence manufacture of the Lockheed P2V-7 for the Maritime Self Defense Force. At a production rate of one aircraft per month, all 42 aircraft to be supplied under the contract should be delivered by March, 1963. The costs of the programme run to some 31,000 million yen and will be borne half by Japan and half by the USA. *Interavia* has recently learnt that a further twelve *Neptunes* are to be built in 1963/64, thus raising the number of P2V-7s for the Maritime Self Defense Force to 70, including the 16 ceded by the U.S. Navy. The Gifu Division's production programme also includes target drones and anti-tank weapons, details of which are not yet available. Development of new surface-to-air and air-to-air missiles is going ahead at full pressure.

At the Kobe works the manufacture and overhaul of Bell 47D and 47G helicopters is continuing. So far Kawasaki has built over 80 Bell 47s, which have been delivered to the Japanese Ground and Maritime Self Defense Forces and Coast Guard, the Burmese Air Force, the Brazilian Navy and many civil customers. The Kobe Division also overhauls American J33, J35 and J57 jet engines. As no production orders have followed the development of the KAL-1 and KAL-2 four-seat touring and communications aircraft, the future of these light models, which were developed several years ago, remains uncertain.

The last of the "big three" is *Mitsubishi Heavy-Industries Reorganized Ltd.*, with its extensive works

Kawasaki's assembly shop at Gifu. This is where the T-33s were assembled.

A Mitsubishi experimental two-stage surface-to-air missile.



Kawasaki KAQ-1 target drone with 72 h.p. McCulloch engine; span 11.5 ft.

at Oye, Komaki and Daiko in the Nagoya area. The first substantial post-war contract for the Aircraft Manufacturing Division of this mighty industrial concern was for the licence production of 300 North American F-86F jet fighters for the Air Self Defense Force. In addition, the American Sikorsky S-55 multipurpose helicopter has been in production at the Komaki plant since last year. After delivery of the S-55 is complete, Mitsubishi hopes to begin production of the Sikorsky S-61 (HSS-2) or the S-62. In this connection it should be mentioned that the Defense Agency envisages building three 10,000-ton carriers for 18 to 24 helicopters each, to be laid down in the coming fiscal year.

In the guided missile sector the Oye plant, in particular, is actively pursuing development work on surface-to-air rockets. Production of parts for Pratt & Whitney radial engines and engine overhaul are in the hands of the Daiko plant. It has already been decided that Mitsubishi will be the prime contractor for the F-104CJ supersonic fighter recently selected for the Air Self Defense Force.

The Shin Meiwa Industry Co. Ltd. developed after the war out of the former Kawanishi Aircraft Co., the major Japanese manufacturer of seaplanes, and since the opening of its Itami plant at the edge of Osaka Airport has specialized in repairs to military aircraft and engines. At its Konan plant on Osaka Bay Shin Meiwa repairs and services American seaplanes of all sizes and manufactures components for the Lockheed/Kawasaki P2V-7 and certain Vertol helicopters. The firm also has several aerodynamic and hydrodynamic research laboratories and facilities for aeronautical research in general. The experience gained will be used for a twin-engined seaplane trainer and other projects.

Engine production ?

Unlike the airframe industry, the engine manufacturers have so far developed no production programme of their own. Apart from repairs and the manufacture of components for certain Western jet and piston engines, engine companies for the time being live on expectations. One of their hopes lies in the *Nippon Jet Engine Co.'s* J3-1, a development of the JO-1, on which work began five years ago. After reaching production status this eight-stage axial compressor engine with about 2,650 lb thrust was to have been manufactured and installed in the Fuji T1F jet trainer by *Ishikawajima Heavy Industries Co. Ltd.*, one of the leading firms in the Nippon Jet Engine consortium. It is not, however, likely that those concerned will be able to wait until the J3 is ready, and it is more probable that the Bristol *Orpheus BOr.4* will be used. Ishikawajima has built the J3 prototype and is producing, at its Tanashi facility, components for the J47 jet engine for the North American/Mitsubishi F-86F. Whether Ishikawajima's plans for licence production of the General Electric J79 for the F-104 will materialize, remains uncertain. At the moment official opinion regarding the manufacture of jet engines in Japan seems divided, and is likely to remain so unless it becomes apparent that large production runs will be necessary. In the rocket motor field the Aviation Division of *Fuji Precision Machinery Co. Ltd.* can expect substantial contracts for solid-propellant motors and will play a significant role in the development of guided missile powerplant systems.

Final assembly of the North American F-86F jet fighter at the Komaki plant of Mitsubishi's Nagoya Aircraft Division.

From the Japanese Aircraft Industry's Catalogue

Airframe Manufacturers and Aircraft Repairs

Fuji Heavy Industries, Ltd.
C. Itoh Aircraft Maintenance and Engineering Co., Ltd.
Japan Aircraft Maintenance Co., Ltd.
Japan Aircraft Manufacturing Co., Ltd.
Kawasaki Aircraft Co., Ltd.
Mitsubishi Heavy-Industries, Reorganized, Ltd.
New Tachikawa Aircraft Co., Ltd.
Shin Meiwa Industry Co., Ltd.
Showa Aircraft Industry Co., Ltd.

Guided Missile Manufacturers

Fuji Precision Machinery Co., Ltd.
Kawasaki Aircraft Co., Ltd.
Mitsubishi Heavy-Industries, Reorganized, Ltd.

Engine Manufacturers

Fuji Motor Corp. (licence manufacture of Continental piston engines).
Fuji Precision Machinery Co., Ltd. (solid-propellant rocket motors).
Ishikawajima Heavy Industries Co., Ltd. (Spare parts for GE.J47 jet engines; construction of JO-1 and J3-1 prototypes; possible licence manufacture of GE.J79).
Kawasaki Aircraft Co., Ltd. (piston engine development).
Nippon Jet Engine Co., Ltd. (development of J0-1 and J3-1 jet engines).

Electrical and Electronic Equipment

Fuji Communication Apparatus Manufacturing Co., Ltd.
Hitachi, Ltd.
The Japan Radio Co., Ltd.
Mitsubishi Electric Manufacturing Co., Ltd.
Nippon Electric Co., Ltd.
Tokyo Precision Instrument Co., Ltd.
Tokyo Shibaura Electric Co., Ltd.
Toyo Communication Equipment Co., Ltd.

Guided missiles on the way

Since the Defense Agency issued details of its new six-year defence programme, Japanese guided missile plans have come into the limelight. According to the programme the Ground Self Defense Force will receive American *Nike Ajax, Nike Hercules* and *Hawk* rockets for the anti-aircraft defence of towns, armament plants and strategically important defence installations; the Air Self Defense Force will be equipped with ramjet *Bomarc* missiles and the Maritime Self Defense Force with *Tartar* anti-aircraft missiles. It is intended to produce large numbers of some of these weapons in Japan (e. g., 600 *Nike Hercules* or *Hawks* from 1962 onwards; 240 *Bomarcs* from 1965 onwards etc.), so that all the leading aircraft manufacturers can be given a new line of activity in the missile sector. An air-to-air missile (designation unknown) developed and tested by Fuji, has been in production for some time, and more than 1,500 have already been completed. Licence manufacture of the *Sidewinder* air-to-air missile is to begin in 1961.

Aviation Electronics . . .

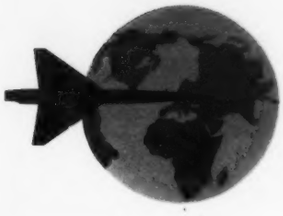
. . . can only be mentioned briefly in this limited space, although it has become the corner-stone of the Japanese equipment industry in recent years. Dozens of firms manufacture radio navigation and radar equipment, guidance and fire control systems. It is possible here to take only a few names from the catalogue of the Society of Japanese Aircraft Constructors: Hitachi Ltd., The Japan Radio Co. Ltd., Mitsubishi Electric Manufacturing Co. Ltd., Nippon Electric Co., Nippon Aviatronics Co. (newly founded by Nippon Electric and Hughes Aircraft), Tokyo Shibaura Electric Co. Ltd., etc.

*

From the foregoing it is clear that even in the reconstruction phase the Japanese aircraft industry is in no doubt as to the lines along which it should develop. These are, broadly, the extension of the equipment industry and the limited production of military aircraft and guided missiles, coupled with the manufacture of economical turboprop airliners for the export market. On the horizon, however, there can already be seen a market for low-priced light aircraft, in which Japanese manufacturers will compete with their agricultural aircraft, multipurpose STOL aircraft and... low wages.

The Japanese services' Sikorsky S-58 helicopters are maintained and overhauled by Mitsubishi.

F-86F jet fighters at the Mitsubishi Komaki plant.



What's in the Air?

● **Panair do Brasil** celebrated its 30th anniversary on October 22nd. The company has an unduplicated route network of 53,757 miles and is serving 60 cities on four continents; its aircraft have crossed the South Atlantic 5,800 times to date. Panair's current fleet comprises four Douglas DC-7Cs, four DC-6Cs, twelve Lockheed 749 *Constellations* and five *Catalina* flying boats. Four Douglas DC-8 jetliners are on order for delivery in 1960.

● **Compañía Mexicana de Aviación** has signed a contract with de Havilland for three *Comet 4Cs*; the total order, with spares and ancillary equipment, is valued at approximately £5 million. The first two *Comet 4Cs* are scheduled for delivery this month, with the third to follow in mid-1960.

● **The first of 17 Boeing 707-328s** on order for Air France was handed over to the carrier's representatives at Seattle on October 20th; the aircraft has been christened "Château de Versailles."

● **BOAC Managing Director Basil Smallpeice** has reported improvements in the carrier's operating costs. The cost of producing a capacity ton-mile in 1956–57 was 40 pence, while the 1959–60 figure is expected to be 35d., and that for 1960–61 under 30d. 1957–58 engineering costs were 10.5d. per capacity ton-mile, but this figure was reduced to 9d. in 1958–59; it is expected to be reduced to 7d. in 1959–60 and 5.5d. per capacity ton-mile in 1960–61.

● **The Deutsche Lufthansa Annual General Meeting** on October 27th approved a proposed increase in the company's capital by DM 60 million up to a total of DM 180 million. New stock will be offered to the present shareholders. — Lufthansa plans to bring the Boeing 707 into service on the Frankfurt–San Francisco route on May 14th, 1960; initial frequency will be two flights weekly, with intermediate stops at either Montreal or Toronto. These services will be run under the Air Union agreement; Air France is the only other member of Air Union to serve the U.S. West Coast.

● **The Royal Swedish Air Force** has signed a contract with Curtiss-Wright Corporation for the purchase of seven Saab-35 *Draken* flight simulators; the order is valued at approximately 30 million Swedish crowns ($5.8 million), and the contract calls for delivery of the first simulator in about 12 months. The new equipment will not only be employed for training in standard flight and emergency procedures, but will also permit full tactical training including the attack, and navigation back to the home base.

● **The Federal Republic of Germany** can now build its own anti-aircraft guided missiles following the meeting in London on October 22nd of the Council of Western European Union. The latter agreed to strike surface-to-air and air-to-air missiles off the list of weapons which West Germany was forbidden to manufacture when she entered NATO in 1955. It is now anticipated that the *Hawk* GAM and the *Sidewinder* AAM will be manufactured under licence in the Federal Republic.

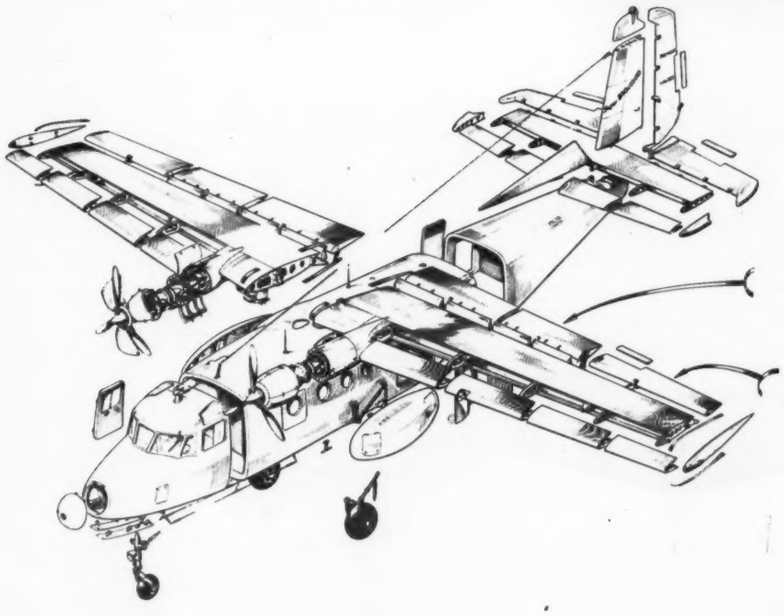
● **The Austrian Air Force** plans to set up, in spring, 1960, in conjunction with the civil air traffic control centres, a radar network covering the whole of the airspace over Austrian territory. The necessary funds for this project have already been made available.

● **Secretary of the Air Force James Douglas** has said that the USAF's strength will be cut by 20,000 men by June 30th, 1960. The money saved will be used for missiles, air defence weapons and the development of the North American B-70 *Valkyrie* bomber. Washington gave the strength of the USAF at July 31st, 1959 as 838,702.

● **Pentagon spending** will drop to about $40,500 million in the fiscal year beginning next July 1st, a reduction of about $500 million on the outlays expected for the current fiscal year. Practically all the reductions contemplated would be absorbed by the USAF. The defence spending budget for fiscal 1961 will be allocated as follows: U.S. Air Force $18,100 million ($18,700 million for fiscal 1960), U.S. Navy $11,600 million ($11,600 million), U.S. Army $9,300 million ($9,300 million), Office of the Secretary of Defense $1,500 million ($1,400 million).

● **Details of the Bristol T.188 research aircraft** have recently been released. Although it is officially stated that the T.188 has been designed for speeds in excess of 1,500 m.p.h., it is understood that the aircraft will

The first Canadair CL-44 transport aircraft was recently completed. The version shown here, of which twelve have been ordered by the Royal Canadian Air Force, has conventional loading hatches in the side of the fuselage. A swing-tail rear-loading version has been ordered by the Flying Tiger Line (ten) and Seaboard & Western (five).



Société Nouvelle des Avions Max Holste and Nord-Aviation will collaborate closely in the production and improvement of the Max Holste MH.260 Super Broussard *transport and business aircraft, powered by two Turbo-méca* Bastan *propeller turbines. The pictures shows the main components of the MH.260 and a view of the model.*

The Beech Model 65 Queen Air *business aircraft for six to seven passengers, powered by two 340-h.p. Lycoming supercharged engines. All-up weight 7,700 lb; useful load nearly 1.5 tons; max. speed 207 kt; cruising speed 174 kt; max. range 1,380 n.m. Deliveries of the* Queen Air, *which is equipped with weather radar, will start in early 1960. Price of standard version $120,000.*

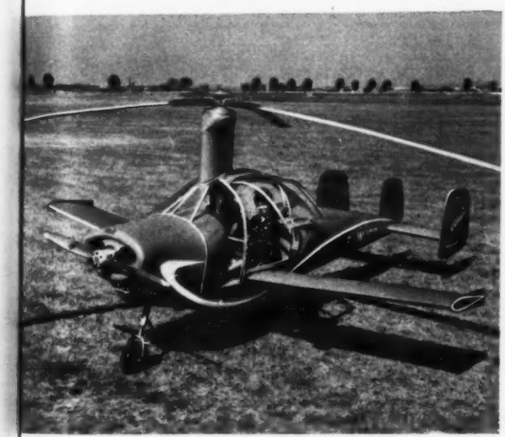
be used for general research work at speeds of around Mach 3. The two de Havilland *Gyron Junior DGJ.10* jet engines (with reheat) are mounted in the wings, which have a straight inboard section and swept outer section; the high-set tailplane is all-moving. The T.188's general appearance is that of a stretched and slimmed *Canberra*. Although it is designed for very high speeds, its shape is extraordinary when compared with current design developments in other countries. First flight of the T.188 is expected in 1960, and the aircraft may be exhibited at the next Farnborough Show.

● **Dassault Mirage IIIB No.01,** the first two-seat *Mirage III,* made its first flight at Melun-Villaroche on October 20th. The only difference between the *Mirage IIIB* and the *Mirage III* is in the cockpit layout, which makes provision for an instructor's seat behind the pilot. The fuselage is lengthened by only 6 inches with respect to the production *Mirage III*. The new version is designed, not for pilot schools, but for operational training of pilots in all-weather flying and high-altitude interception.

The Umbaugh U-18 helicopter with 180-h.p. Lycoming engine and tandem seats. It has a three-blade rotor, a two-blade pusher propeller and conventional control surfaces. Fairchild will manufacture the U-18 under licence to the Umbaugh Aircraft Corporation.

● **MAN Nuremberg** is to develop a new supersonic engine designed by Rolls-Royce. The engine is known as the RB.153 and employs the principle of variable turbine blades. The RB.153 is believed to be a developed form of the RB.145, for speeds around Mach 2 and above. One known application is the Messerschmitt-Heinkel VTO fighter for speeds around Mach 2.

● **Thirteen USAF B-58 Hustler bombers** have completed their flight test programme and will be returned to Convair's Fort Worth plant for conversion into tactical aircraft. One major modification is the installation of new and improved models of the General Electric J79 jet engines. The 13 test aircraft will be modernized to the same standards as the 25 new aircraft coming off the production line.



Hélicop-Air Girhel *two-seat gyroplane. The model shown here, the L.50, is powered by a 90/95-h.p. Continental engine: an L.51 version with a 150-h.p. Lycoming engine is also planned.*

● **Boeing Airplane Company,** of Seattle, Washington, has announced the first details of the Boeing 735 cargo aircraft, a derivative of the Boeing 707. Of particular interest is the fact that the 735 will be powered by turbofan engines similar to those on the B-52H bomber and the 707-120B (Pratt & Whitney JT3D-1) and 720B passenger versions. — J.B. Connelly, Vice-President and General Manager of Boeing's Transport Division, said that the Boeing 735's operating costs are 3 cents per ton-mile, and that the aircraft will be available by 1961. It will have a swing-tail configuration to simplify loading and unloading.—The first data on the 735 are: range over 2,600 n.m. with 100,000 lb of freight (range with reduced payload is over 5,000 n.m.). The 735's hold capacity is 9,000 cu.ft.; cruising speed will be around 520 knots.

● **Bell Helicopter Corporation** is to build, under contract to the U.S. Navy, a new multipurpose helicopter, designated HUL-2, which will give higher than average performance at reduced maintenance costs. The HUL-2, which is a variant of the now operational HUL-1, will be powered by a 250-h.p. Allison

● **Production of the 240-h.p. Potez Type 4D32 light engine** for the Nord 3202 trainer is continuing, and the 260-h.p. Type 4D34 engines for the Nord 3400 artillery observation aircraft began coming off the assembly line early in October. At the CEP Saclay facility official type certification tests are continuing on the 90-h.p. Potez 4E engine, which has already completed factory tests. Six other 4E engines are being assembled or undergoing acceptance tests.

● **Bensen Aircraft Corporation** has brought onto the market a new ultra-light helicopter, the *Little Zipster*. Of extremely simple fuselage structure, the new helicopter is driven by two contra-rotating two-blade rotors and has a tail stabilization fin; it is powered by a Mercury MK 78 (70 h.p. at 5,600 r.p.m.). Rotor diameters are 22 ft and 20 ft respectively; weight equipped 450 lb; normal all-up weight 700 lb. Performance is as follows: cruising speed about 50 knots; maximum range 90 nautical miles; maximum endurance two hours; ceiling 11,000 ft; hovering ceiling 6,000 ft; maximum rate of climb 900 f.p.m.

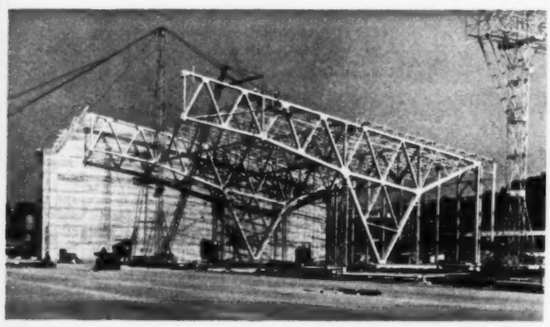
● **The two-seat Breguet 906 Choucas sailplane,** a derivative of the single-seat 905 *Fauvette,* began flight tests at Toulouse–Blagnac on October 26th.

The first of five Boeing 707-329s (Intercontinentals) *ordered by Sabena, at the Renton plant on the shore of Lake Washington: it is being delivered at the beginning of this month. The Sabena version will have 134 seats and will be powered by four Pratt & Whitney JT4A-3 jets. It will be used from February 15th, 1960 onwards to run four direct services weekly between Brussels and New York and a once-weekly Brussels–Rome–Leopoldville–Johannesburg service.*

At the end of the year the Indonesian Navy is taking delivery of these two and four other Fairey Gannet AS.Mk-4s *for use in anti-submarine operations. These are former Royal Navy aircraft which have received a thorough overhaul and been fitted with new Bristol Siddeley* Double Mambas. *A further twelve aircraft, of which two have been converted from* T.Mk.2s *to* T.Mk.5s, *are to be delivered by 1961.*

In connection with awards of contracts to Marconi's Wireless Telegraph Company for the supply of electronic equipment for the Swedish air defence system (cf. Interavia *Review 11/1959, page 1324), representatives of the Royal Swedish Air Board recently visited the company's Chelmsford works and the research and development laboratories in Great Baddow. Left to right: Colonel Hamilton and General Rapp of the Royal Swedish Air Board, Dr. E. Eastwood, Manager of Marconi's Research Division, and Mr. Keall, also of the company.*

Conversation at the 9th General Meeting of the NATO Advisory Group for Aeronautical Research and Development (AGARD) in Aachen on September 24th and 25th. Left to right; Lieut.-General Bernard A. Schriever, Commander of USAF Air Research and Development Command: Dr. Theodor Benecke of the Federal German Ministry of Defence, and Dr. Theodore von Kármán, Chairman of AGARD since its foundation.



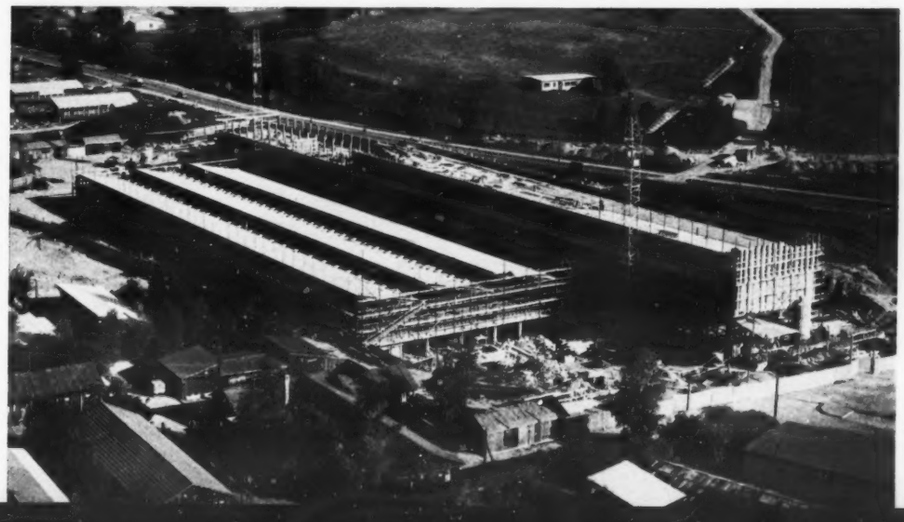
Work on the second phase of the Zurich-Kloten Airport development scheme is progressing satisfactorily. No. 2 maintenance hangar has reached a more advanced stage of construction than shown in the picture, and 800 tons of steel will be required to build it. Covering an area of 1,269,377 sq. ft. and costing SFr. 14 million, the hangar is scheduled for completion in summer 1960. It will accommodate two Douglas DC-8s and two Convair 600 Coronados.

YT63-A-3. According to Bell's engineers the new helicopter will have a hovering ceiling of over 15,000 ft, a maximum rate of climb of 1,300+ f.p.m. and a maximum speed of over 87 knots. Vertical rate of climb is about 1,000 f.p.m., range is 175 n.m. The HUL-2 will have metal rotor blades and a four-seat layout. Basically, apart from the fact that it is turbine-powered, it is the military equivalent of the Bell 47J *Ranger* civil helicopter.

● **Kaman Aircraft Corporation,** of Bloomfield, Conn., has begun flight-testing its new HU2K helicopter. The HU2K, powered by a General Electric T58 turbine, will go into production at the beginning of next year. Though no details of performance have yet been issued, Kaman says that the HU2K's speed and range will be vastly superior to those of helicopters at present in operation. The company intends to introduce the HU2K on the civil market, and for this purpose an FAA certification programme is being prepared.

● **Canada's principal air survey firms** are to cooperate in a $1.3-million hydroelectric power and irrigation survey of the Mekong River in Southeast Asia. The project will include air photography, ground survey and mapping, and is being financed by the Canadian Government under the Colombo Plan; the two-year commitment is scheduled to start in November and is part of an international development project conceived by the U.N. Economic Commission for Asia and the Far East. — Photographic Survey Corp. of Toronto has received a contract to act as management engineers for the project. Other companies participating are: Aero Surveys Ltd. of Vancouver; Canadian Aero Service Ltd. of Ottawa; McElhanney Nelson Air Survey Ltd. of Vancouver; Spartan Air Services Ltd. of Ottawa; and Compagnie Photo-Air Laurentide of Quebec City.

Handling of mail and freight at Zurich-Kloten Airport, at present carried out in temporary huts, will take place in this new building, which will be completed in late summer, 1960. Building costs amount to SFr. 8 million.



● **Bordeaux-Mérignac Airport's** new terminal building was officially opened for business on November 8th. Mérignac's No. 1 runway has a length of 7,875 ft, and No. 2 runway is 6,560 ft in length; the latter is to be reinforced and extended to 8,330 ft in 1960.

● **SAS Scandinavian Airlines System** has signed an agreement with Aeronaves de México covering the sale of six SAS Douglas DC-6s to the Central American carrier; the agreement covers spare parts and SAS training of pilots and ground personnel for Aeronaves. This completes the disposal of SAS's fleet of DC-6s, three already having been sold to Guest Aerovías of Mexico and three to Transair of Sweden.

● **The SNECMA Atar 8 turbojet** (9,700 lb thrust) has successfully completed a further series of catapulting tests at the Etablissement Aéronautique de Toulouse (EAT). For this purpose EAT has a special installation on which the test engine is driven on a sled along a 4,270-ft track. During these recent tests the engine made 100 simulated "catapult take-offs" at accelerations up to 6 g.

● **The Bristol Siddeley Orpheus 12** flew for the first time on November 10th in a North American *Sabre*, which is being used as a flying test bed.—The *Orpheus 12* develops a dry thrust of 6,810 lb, which is increased to 8,170 lb by the use of a simplified form of reheat.

● **Bell Helicopter Corporation** reports that a new version of the Bell 47, designated 47G-3, is ready to go into production. First deliveries are planned for March 1960. The Bell 47G-3 will reportedly be able to reach ceilings of about 16,400 ft with maximum payload.

● **A Douglas C-133B Cargomaster** airlifted a fully-assembled *Atlas* missile from San Diego to Cheyenne, Wyoming, during a test carried out on November 10th. The B version of the *Cargomaster*, which is in production at Douglas Aircraft Company's Long Beach Division, can carry more than 26 tons for a distance of 4,000 miles at an average speed of 323 m.p.h. Powerplant consists of four Pratt & Whitney T34-P-9W turboprop engines.

● **The first Pirna 014 jet turbine** underwent its first tests on a temporary rig at Pirna's development plant (near Dresden) in mid-October 1956. By the end of 1957, the first four fully-equipped test stands were completed. Their U-shaped tunnels have a total length of 210 ft and a cross-section of 23 × 24.6 ft. Three of these test stands are for tests of complete engines, the fourth for compressor tests. There is a central tank installation with a capacity of 145,180 Imp.gall. Today several test stands, with tunnel lengths of 330 ft and cross-sections of 26 × 26 ft, are nearing completion. These are designed for tests of complete double engines (Type 152). Two smaller stands for special tests and the testing of small gas turbines are also availlable at Pirna. During the coming year a fluid flow laboratory will also be completed, whose equipment will include a low- and high-speed cascade test stand and a compressor test rig for extreme rates of flow. This facility will be completed by a low-temperature chamber with a useful volume of 796 cu.ft., to be used for tests at temperatures down to –133 °F.

● **Republic Aviation Corporation** reports the successful flight testing of a water injection system for the Pratt & Whitney J75 jet engine powering the Republic F-105 fighter-bomber. The J75's thrust with reheat is normally over 24,000 lb; this can be raised by about 2,000 lb by using the water injection system.

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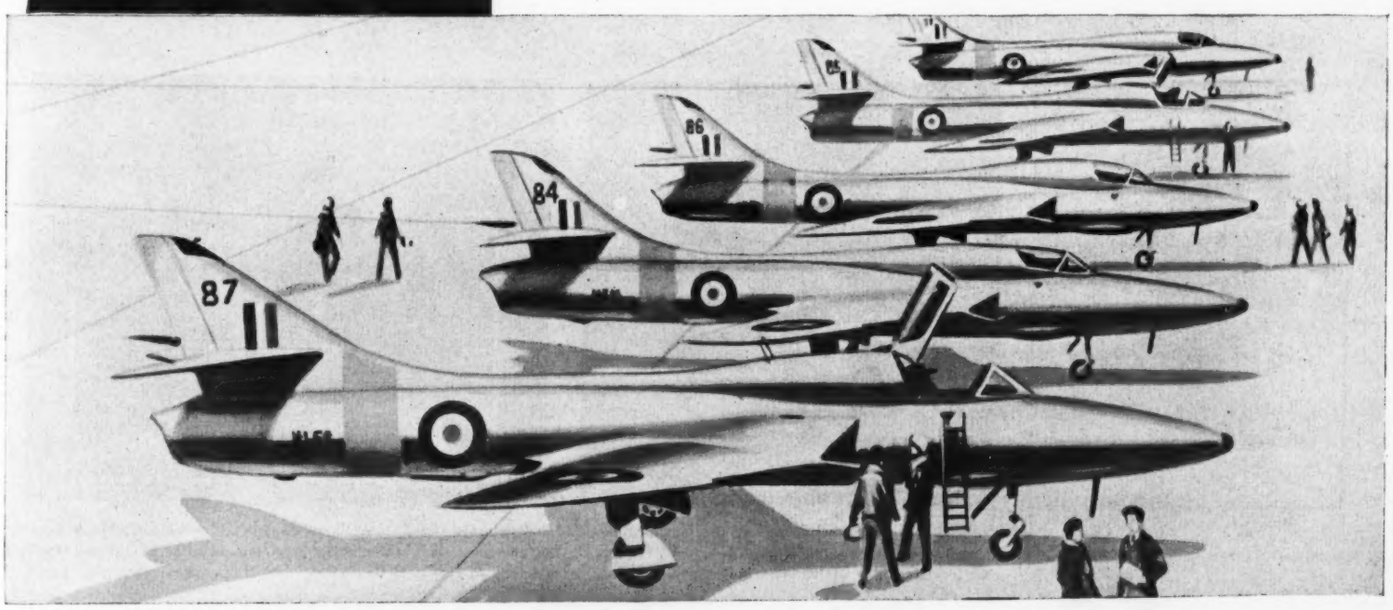

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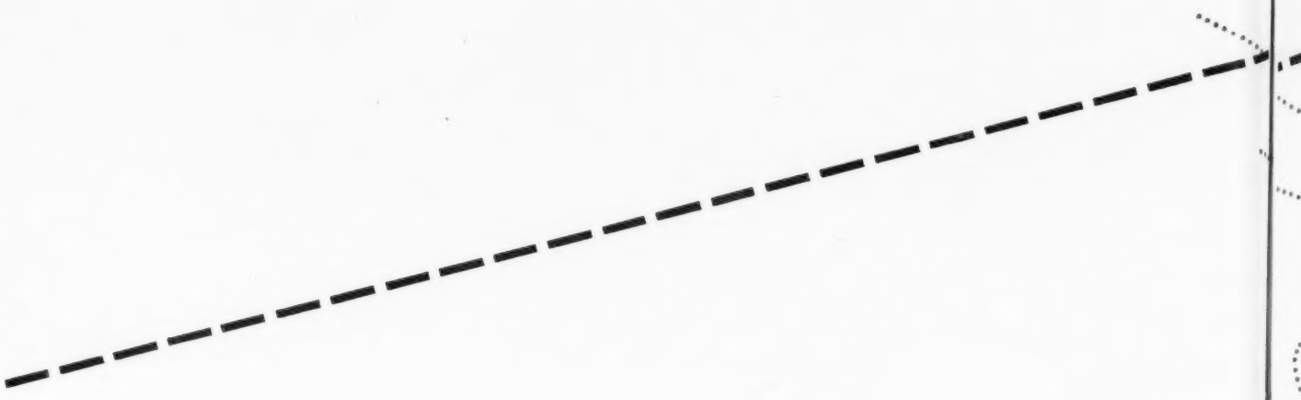

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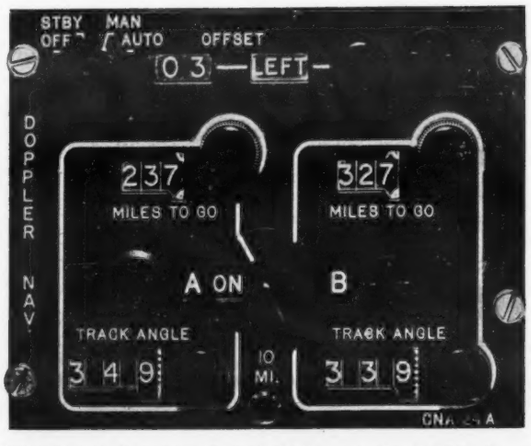

Navigational Computer Control Box is standard RTCA form factor panel allowing selection and presentation of desired track, distance to go, and deviation from track on a "two-leg" basis.

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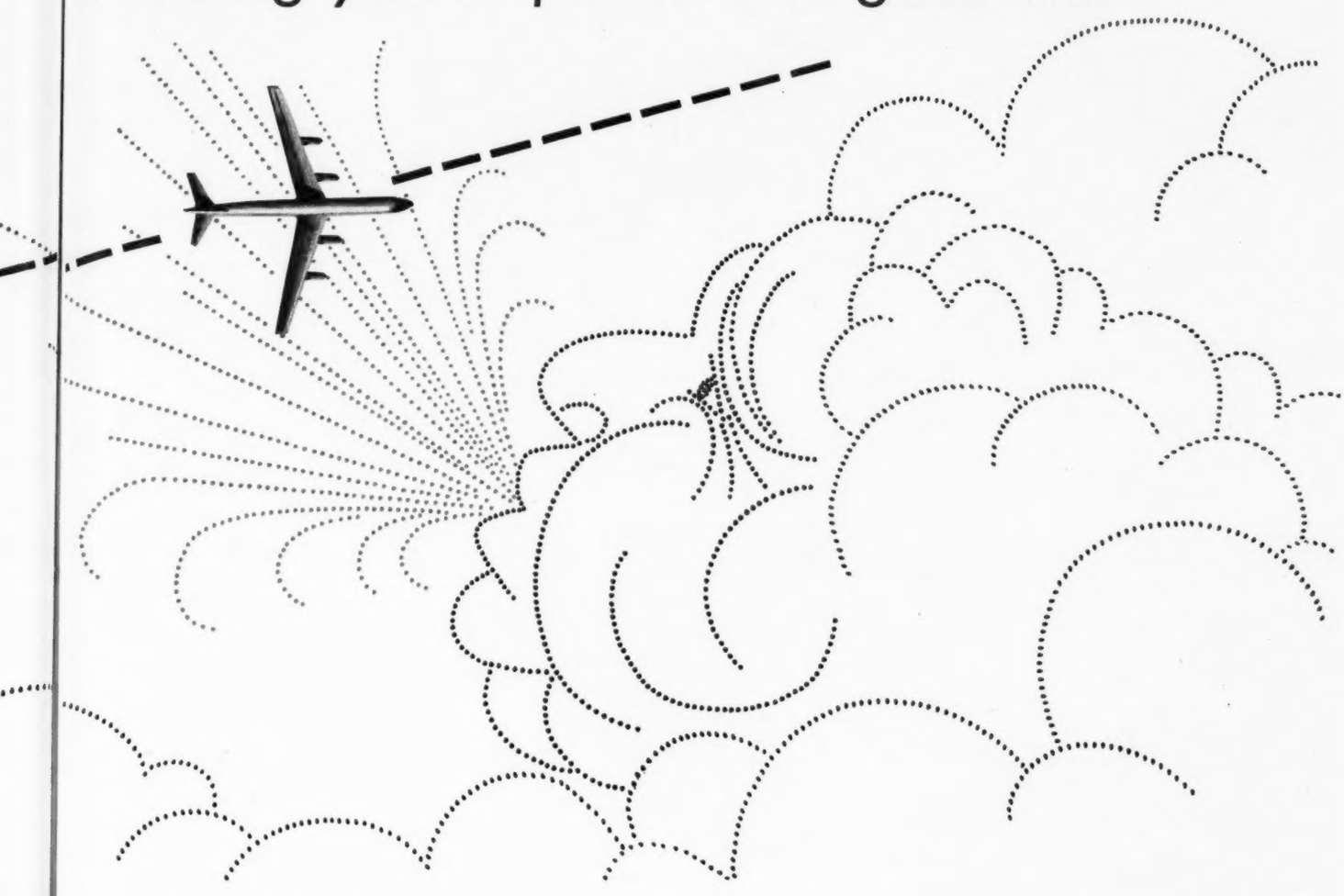

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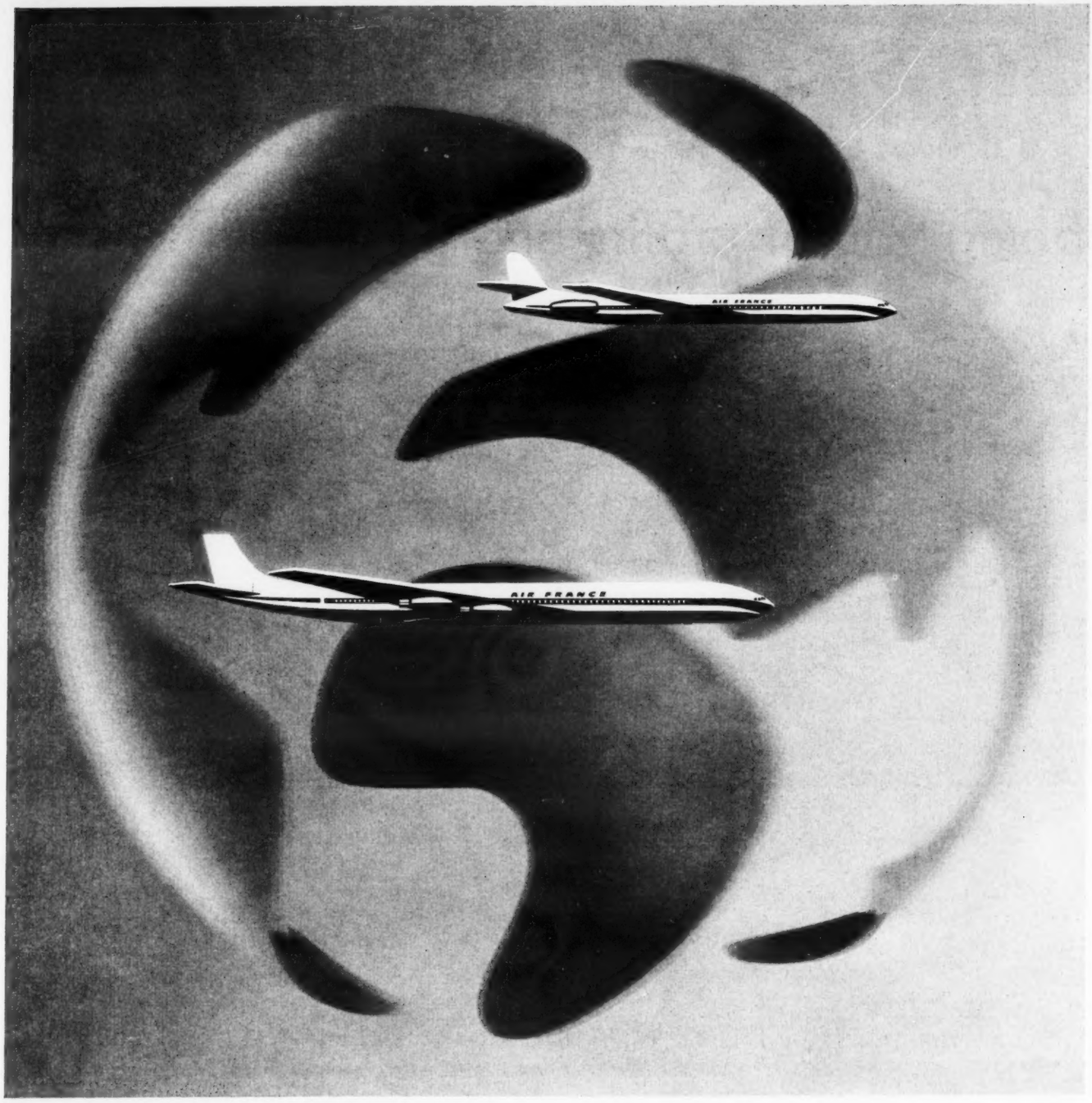

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The CARAVELLE *is now in service on most of Air France's Middle East and European network :* PARIS-BEIRUT, PARIS-ROME-ATHENS-ISTANBUL, PARIS - MILAN - ATHENS - ISTANBUL, PARIS - LONDON, LONDON - NICE, NICE - ROME, LISBON - PARIS, PARIS - TEL AVIV, PARIS - ALGIERS, PARIS - WARSAW - MOSCOW.

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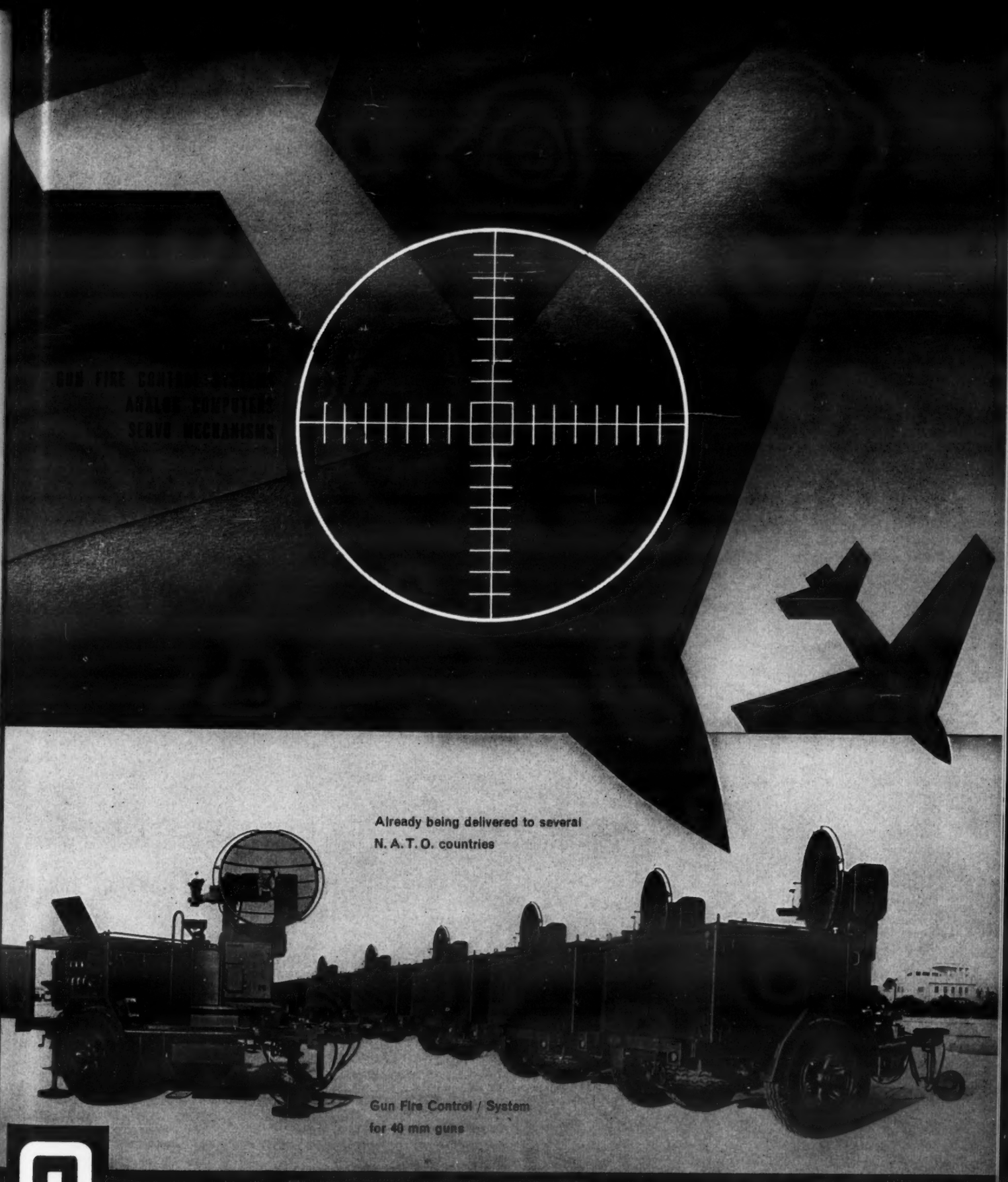

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A British Space Flight Programme Based on Blue Streak*

by G. K. C. Pardoe, B.Sc., Chief Coordinator (Ballistic Missiles), De Havilland Propellers Ltd., London

G. K. C. Pardoe, B.Sc., the author of this article, seen holding a model of the modified *Black Knight* rocket and satellite which he suggests for a British space flight programme.

The intention of the British Government to participate in space flight was indicated by a Government statement in May 1959. Many important objectives have already been defined to support sending equipment into space. For one thing, the subject of communications has been of particular interest from both military and commercial viewpoints, and for another there is a wealth of scientific knowledge to be obtained about the properties of our earth and its atmosphere, as well as its relationship with other bodies both inside and outside our solar system. The field of exploration is so vast that no more than a fraction of it can *ever* be covered by man, let alone by a few hundred space probes in the next few years !

In Britain we have already embarked on a military ballistic missile project for a weapon in the same class as those used in the United States and Russia for launching space vehicles. The existence of our military project in the United Kingdom is already of prime importance; many new problems have had to be overcome, and valuable experience has been gained which will inevitably yield great benefits. The 24-hour satellite is a well-quoted example of direct application to telecommunications.

Commonwealth participation

There is not the slightest doubt that the production of a system to achieve space flight is a major and costly undertaking and at present can be attempted only by the major powers in the world. It is a question of finding not only the large sums of money to finance the work, but also of possessing the necessary technical skill—and then, of course, there is the geographical requirement.

The British Commonwealth has a tremendous advantage in its terrestrial coverage: in addition to the launching sites already being built at Woomera, Australia, there are several other desirable places at which space vehicle launching sites could be established with great advantage. Also, to track vehicles, Commonwealth territory provides unique facilities. The radio-telescope at Jodrell Bank in the United Kingdom is well known. An important base has also been established at Singapore which already provides valuable tracking information and, of course, Australia is equipped to play an active part in space exploration. Britain and Australia respectively are already busily engaged in the construction of the *Blue Streak* ballistic missile and its associated testing and launching facilities; Canada too has a large amount of experience on guided missiles and aircraft and, it is reported, has already indicated its interest in participating in space experiments.

Objectives

Inevitably, Russia and America will constantly strive to match each other's major achievements since, for one thing, they are in a position to compete with each other, and there is a wealth of information and prestige to be gained by so doing. However, in concentrating their efforts on these extended missions, they will doubtless leave many zones of interest, of a less glamorous nature, comparatively unexplored. The best returns do not always come from the most exciting investments, and if we could equip ourselves with a means of moving in terrestrial, cislunar and translunar space, we should be covering the zones of interest most likely to be of direct value to the earth's inhabitants for many years to come.

To be more specific, the experience and technique acquired in producing a vehicle to travel from here to the moon is of the same value as that gained in producing a vehicle to travel to Mars. The difference between these two missions is largely one of size of vehicle, accuracy of guidance and navigation, and an extended form of communication or guidance for the interplanetary flights. From pure energy considerations, however, one requires a similar energy to establish a given payload in a 24-hour orbit round the earth as to send the same payload on a one-way trip to Mars.

In my view, the real zone of direct interest for decades to come is between here and the moon. It would seem, then, that from considerations of what the vehicle should do, and could do, a series of experiments might be planned to project equipment into orbits round the earth; the lowest of these might be about 50 nautical miles and near-circular, and the highest might well be a very elliptical orbit encompassing the moon. We could not expect within these first broad objectives to land on the moon and return to earth (unless someone very kindly supplied a large refuelling satellite around the earth before *Blue Streak* finishes its useful life as a space vehicle !).

Vehicle performance requirements

Within the broad missions discussed above, the total velocity required for a complete vehicle would be in the order of 37,000 feet per second for the most ambitious case, but only 25,000 feet per second for a lower orbit condition. Payloads weighing as little as 150lb can be judiciously packed with productive instruments (as already clearly demonstrated). However, looking further ahead, a very profitable amount of equipment can be packaged in a payload of some 500 lb, while payload weights of the order of 1,500 lb can give corresponding improvements in reliability, duration of operation and extent of information obtained. Payload weights of about 1,500 lb are probably the absolute minimum for capsules containing a man. It will be demonstrated later that something in the order of 2,000 lb is probably the maximum payload which could be sent into space using the existing *Blue Streak* as the first stage. Within the present objectives it is therefore not reasonable to include a man-carrying mission, in view of these limitations.

Vehicle configuration

In view of the advantages of using as much existing equipment and facilities as possible in the early experiments in space flight, the first stage of our space vehicle is a substantially unaltered *Blue Streak* missile. It is fully appreciated that the greatest concentration of energy should be contained in the upper stages, and that an optimum design would make use of exotic high energy propellants. In considering contemporary equipment we are not, therefore, presenting the best performance that can be obtained.

Aiming at simplicity in the first example, let us consider what might be obtained by the use of a simple solid second stage to *Blue Streak*. *Figure 1A* shows one possible configuration. The second stage is formed by a twin solid rocket motor propulsion unit, each of the rockets being based on an existing design. Instead of locating the payload at the head of the propulsion unit in the orthodox manner, one might divide it into two canisters indexed with the twin motors as shown. This gives convenient packaging of the second stage and payload, and a more compact configuration.

It can be seen that a light fairing is suggested, stretching from the front over the second stage and payload. This fairing is fitted to reduce drag in the early ascent phase, and to reduce kinetic heating input to the forward equipment. On leaving the atmosphere, or on the completion of first stage burning, the fairing can be jettisoned by the compressed air or H.T.P. unit shown diagrammatically at the front end. The unit would give a small lateral force sufficient to separate the two longitudinally divided sections and to pivot the fairings on the rear outer edge, away from the then exposed second stage. This fairing achieves greater importance in the later configurations which we shall examine. Between the second stage and the front tank section of the first stage, a bay is shown which

* This article is a condensation of the paper presented by the author to the Commonwealth Spaceflight Symposium in London earlier this year.

will house an inertial guidance system. The capabilities of this simple two-stage vehicle are strictly limited to near-earth satellite work, and the guidance developed for a military role should have more than enough accuracy to control the first stage flight. With the simple solid second stage shown, second stage guidance would be rather difficult to incorporate, and it is suggested therefore that differential deflections of the rocket venturis would provide the appropriate rate of rotation for the second stage, thus stabilizing it during its burning time; therefore, to achieve the appropriate accuracy of the payload in orbit, the first stage guidance would have to be relied on to place the vehicle correctly at the end of first stage propulsion. On completion of second stage propulsion, the payload could easily be separated from the expended second stage by a small solid rocket or H.T.P. system.

There is nothing new or clever about this proposal for a simple solid rocket second stage. The most important feature is its early availability. If we assume the total weight of the second stage plus payload to be in the order of 8,000 lb, then a suitable velocity increment from the motors could be obtained by allowing an actual payload weight of about 1,000 lb. Thus we reach the conclusion that the existing *Blue Streak* missile —with virtually no mechanical or system change—together with an extremely simple second stage based on equipment already under development, is capable of placing a payload of some 1,000 lb in a 300-mile circular orbit around the earth. Obviously it would not be sensible to embark on a comprehensive space programme based only on the limited capability of a solid rocket second stage, when the use of a more efficient liquid fuel second stage offers far greater potential. The solid second stage would just be a means of getting a payload into space during the interim period.

Another possibility would be to use the Saunders Roe/Royal Aircraft Establishment test vehicle—*Black Knight*—as a second stage for *Blue Streak*. *Figure 1B* shows how this combination might look with a nominal payload on the front. A fair amount of information is publicly available now on the *Black Knight* vehicle. In its basic state it has a quadruple chamber rocket motor system, using H.T.P. and kerosene as propellants. Each of the four chambers produces 4,000 lb thrust at take-off, giving a combined thrust of 16,000 lb, rising to over 18,000 lb outside the atmosphere. Normal length of the vehicle is some 35 ft, and maximum diameter is 3 ft. The distribution of the propellant tanks is as shown in the diagram, with the H.T.P. to the rear and the kerosene forward, and a small bay containing pipe-work, reducing valves, etc., in between the two tanks. The guidance and control equipment is located in a short bay at the forward end of the kerosene tank. Various types of payload can be installed in front of this tank.

It has been suggested that the payload could be about 1,000 lb in weight. This load is well within the capabilities of *Blue Streak*, and the combination looks quite attractive. Its main merit, of course, is that the second stage is already in existence and is demonstrating a remarkably high degree of reliability.

If the long, thin structure of *Black Knight* is to be placed on top of *Blue Streak*, the adapter between the two stages will need very careful designing; and obviously new dynamic bending loads will be produced on the forward tank section of *Blue Streak*, which may or may not demand some structural changes. The long, thin combination will produce different flexural characteristics of the complete vehicle during first stage burning, which in turn will entail some changes in the autopilot system. Although the moment of inertia is higher with the second stage and payload in place, larger excursion angles of the first stage motors may well be involved in certain wind shear conditions during flight through the atmosphere. The use of a liquid fuel second stage poses the problem of in-flight ignition, not only after separation from the first stage, but also after the interruption in burning during second stage propulsion which will almost certainly be required. However, H.T.P. (used with a catalyst) and kerosene should provide comparatively trouble-free remote ignition, and a high degree of reliability is available in this respect.

The geometry of a 1,000-lb payload (should it be of any low density nature) would have to be designed carefully in relation to the *Black Knight* behind it. The H.T.P. tank has a large wetted area, which will be directly exposed to kinetic heating during the early main stage boost phase; fortunately, with H.T.P., this problem is not as severe as with liquid oxygen or liquid hydrogen. Nevertheless it is desirable to minimise the input of heat, not only during the burning periods, but also when the vehicle is in a transfer

Fig. 1A

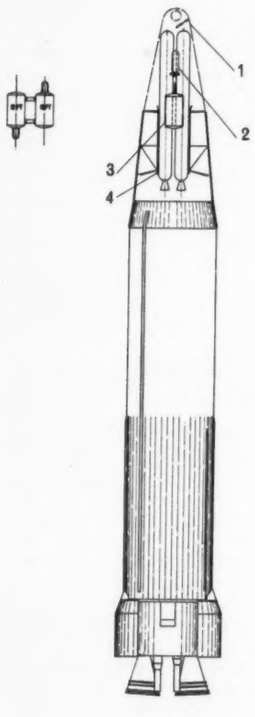


Fig. 1B

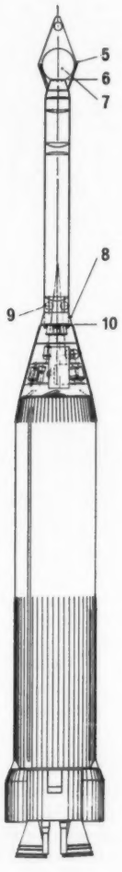


Fig. 1C

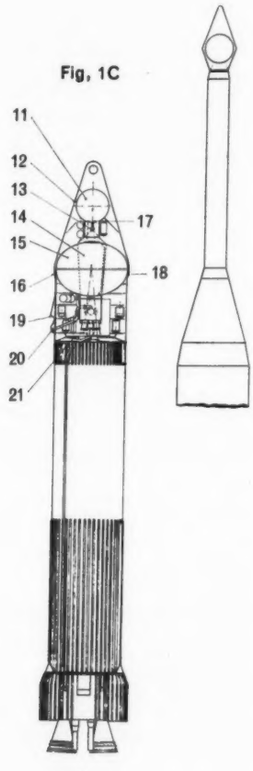


Fig. 1A *Blue Streak* with proposed solid second stage.

1 – Nose cone ejected in two halves at first stage ' all burnt '.
2 – Two attitude correctors & spin stabilizers.
3 – Dual package arrangement of payload.
4 – Launch rails.

Fig. 1B *Blue Streak* with *Black Knight* as second stage.

5 – Nose cone ejected in two halves at first stage ' all burnt '.
6 – Final separation (springs or gas jets).
7 – Payload volume 33.5 cu.ft.
8 – Fairing & support structure replaces existing fins & pads.
9 – Additional pressurized H.T.P. equipment to provide control during separation & coasting periods.
10 – Separation.

Fig. 1C *Blue Streak* with the modified *Black Knight* as second stage. The outline on the right shows the comparison with the layout illustrated in Fig. 1B.

11 – Payload volume 53.4 cu.ft.
12 – Nose cone ejected in two halves at end of first stage.
13 – Ground connections & release mechanism.
14 – Kerosene tank.
15 – H.T.P. tank.
16 – External frame with release mechanism & fairing.
17 – Final separation.
18 – Separation line.
19 – Electrical ground connectors.
20 – Ground connectors for propellants & other services (H.T.P. shown).
21 – Working platform.

or parking orbit, and the wetted surface is subjected to radiation heat from the sun. To avoid the need for insulating the long, thin cylinder, an attitude control device may be required so that the rear end faces the sun during such coasting phases.

As we may be about to embark on serious space vehicle production, it is obviously essential to consider the largest and most efficient second and third stages which could be carried aloft by the only first stage available, i.e., *Blue Streak*. Here improvements to the basic *Black Knight* should be investigated, since *Blue Streak* is capable of lifting larger and heavier vehicles.

There exists, however, a very attractive alternative. The complete propulsion bay of *Black Knight* is an extremely well-engineered piece of equipment, and it is suggested therefore that it should be used in association with modified tanks. Such a deviation from the basic *Black Knight* would incur the minimum risk of development trouble, since a change of tank shape need not be critical. *Figure 2* shows two hemispherical tank domes, joined by a cylindrical section of a length determined by the weight (and therefore volume) which can be lifted by *Blue Streak*. The second stage thus has the same maximum diameter as *Blue Streak*. The relative size of the tanks in the second stage must be chosen to allow for the H.T.P./kerosene burning ratio. It is suggested that the more orthodox lateral separation diaphragm could well be replaced by a longitudinal cylindrical type diaphragm, as shown. The kerosene, having the smaller volume, could be contained within the central tube, and the H.T.P. could be in the outer torroidal container. This has been lightly referred to as a " doughnut " configuration. A higher pressure would obviously have to be maintained in the kerosene tank than in the H.T.P. tank, to avoid compressive stresses on the central tube, but the pressures in both tanks are comparatively small, and this should present no problem.

Figure 1C shows the overall configuration with a transition bay in front of the *Blue Streak* tank. This bay could contain an inertial guidance system and control equipment, as well as encompassing the *Black Knight* propulsion unit. The bay could be extended forwards to join the second stage at the maximum diameter of the tanks. To minimise kinetic heating input to the H.T.P. tank, the forward fairing over the payload could be brought to a slightly larger diameter than the second stage tank domes, and a double-wall insulation thereby provided. This forward fairing could be very light and could be separated (after leaving the atmosphere) in the same manner as described previously for the simple solid stage fairing. Small ancillary rockets would be required in the second stage, for reasons discussed later, and these too could be located in the transition bay. All equipment in the bay would be exposed after main stage separation, but would be protected from kinetic heating and aerodynamic loading during the ascent phase through the atmosphere. The maximum amount of structural weight would therefore be left behind with the first stage. Only a two-stage propulsion vehicle is illustrated, and therefore a nominal payload is shown attached directly to the front of the second stage.

From an overall configuration viewpoint such a modified tank system for the second stage could well be lighter than a longer structure, and the compact shape could easily be blended in

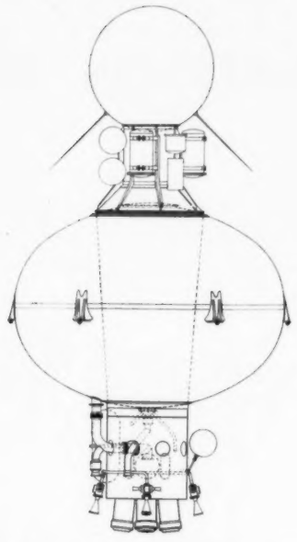


Fig. 2: A diagram of the modified Black Knight *to be used as the second stage in launching a British satellite.* The combination of redesigned tanks and unchanged propulsion unit greatly reduces the overall length of the structure.

with the *Blue Streak* vehicle. The thrust to weight ratio at the beginning of second stage ignition could be 0.8, or even substantially lower in certain circumstances, and so with the 18,000 lb thrust available in vacuo at the beginning of second stage ignition, this could mean a second stage of some 22,000 lb in weight. This assumes no up-rating of the *Black Knight* propulsion system.

Taking, for example, the 300-mile circular orbit which we have discussed earlier, calculations based on the increased tankage indicate that a payload mass of some 2,000 lb could be expected. This represents a substantial improvement over the 1,000 lb suggested for the original *Black Knight* combination.

A further factor to consider is that a short configuration would involve far fewer changes to the *Blue Streak* servicing tower, compared with the introduction of a long thin type of vehicle on top of *Blue Streak*.

So far as the guidance and control of the combination is concerned, it is suggested that, for a start, reliance could probably be placed on first stage guidance using the *Blue Streak* equipment; payload orbit could be achieved by an autopilot in the second stage, using reference data supplied at the beginning of second stage ignition. This would result in a far more accurate trajectory than the spin-stability associated with a second stage solid system. If a suitably small inertial guidance, or a suitable radar command link guidance became available for the second stage, then this could obviously be incorporated, and a further improvement obtained in the trajectory performance.

Looking ahead a little further, should it be necessary or desirable to fit a third propulsion stage, in order to project a smaller payload into a deeper probe, then it would seem comparatively simple to fit it on top of the " doughnut " *Black Knight* second stage.

There would thus seem to be a good potential performance available from the modified *Black Knight*. No new manufacturing techniques are required, and yet a more balanced multi-stage combination is offered, involving less alteration to ground support equipment such as servicing towers; perhaps most important of all, it offers almost twice the payload capability as the basic *Black Knight* when used with the unaltered *Blue Streak*.

To summarize the different programmes which might be followed to produce a space vehicle, we have at one extreme the simple treatment—with limited capability—using a solid rocket system able to place, say, 1,000 lb in a 300-mile orbit. At the other extreme, we have a more elaborate liquid propulsion system second stage based on existing equipment, able to place a payload of some 2,000 lb in orbit at 300 miles altitude; between these two we have a half-way stage where *Black Knight* in its present form (and thus readily available) could be used to place about 1,000 lb in orbit at 300 miles. Obviously, these three suggestions are not the only solutions—even without developing a new propulsion system.

Organization, cost and time-scale

A discussion of the time-scale of such activity is obviously very delicate. So much depends on which objective is chosen, on the amount of effort that a government may wish to invest and, not least of all, on the progress of the ballistic missile project on which this discussion is based. Obviously, I can say nothing of the latter, other than that several *Blue Streak* vehicles have been at the test sites for some time, and that the first flight trial cannot be far away. The *Blue Streak* military project must not suffer in the slightest way in order to enable a purely scientific project to go ahead. Furthermore, nothing can be done until the production of vehicles for the military programme is adequate to provide the extra vehicles for the space flight programme. By this time they will have been demonstrated satisfactorily in guided flight with the full system.

Taking all these factors into consideration we are clearly two or three years away from the day when these proposals might materialize. Within this time-scale it would seem quite possible to do the necessary modification, planning and construction work on *Black Knight*, and to design and assemble the payload. If a decision should be taken to use American launcher equipment in the early stages, some payload testing could also be done. However, from the Government statements on this subject, it would seem that the American vehicle (suggested as *Project Scout*) would only be capable of sending a payload of about 150 lb into space, and so only parts of the more important and elaborate British satellite could be investigated.

Deliberately, little detail has been given in this paper on the satellite or payload itself. The Government has initiated a considerable amount of design study work on the form of the payload, and this work is being carried out largely by Government establishments and universities throughout the country.

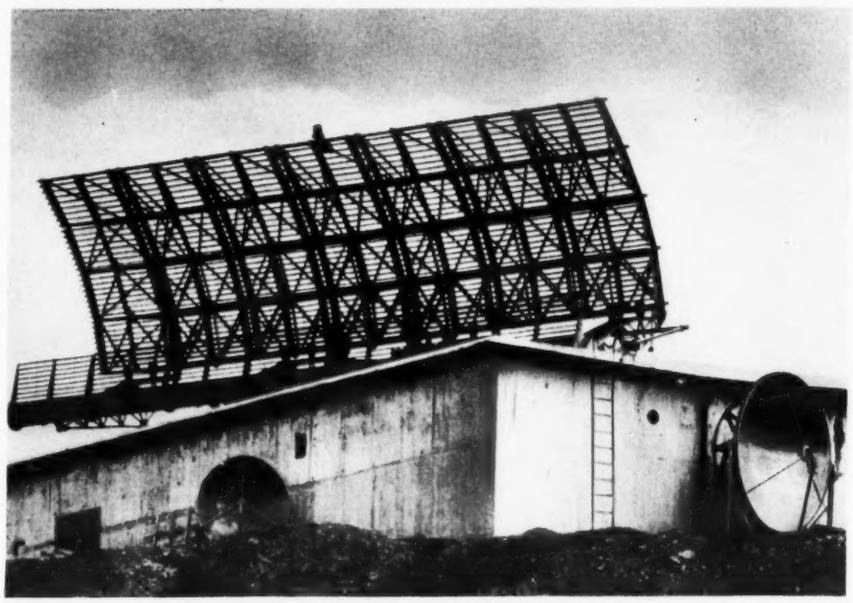
The existence of *Blue Streak* as a potential main stage vehicle for European countries is significant: assuming that the governments concerned would agree to such a move, European nations which do not possess a main stage booster facility could well consider planning a programme using *Blue Streak* as booster for either upper stages or payload, since the design team of the vehicle would be on their doorstep.

Telecommunications and Electronics

Receiver-Transmitter / Converter-Power Supply / Direction-Velocity Indicator

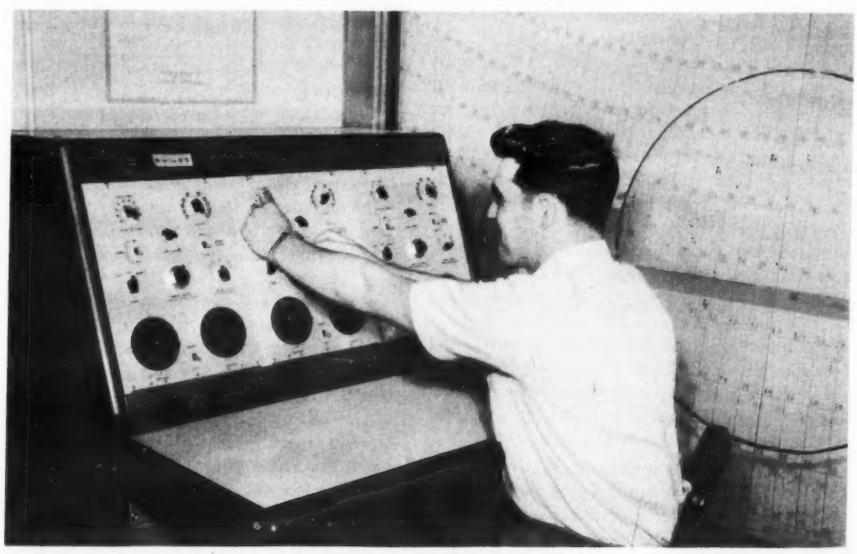
The Ryan Aeronautical Company, San Diego, Calif., has recently issued details of the AN/APN-97 Helicopter Ground Velocity Indicator. The main components of the system are illustrated here and represent a further application of doppler radar techniques to navigational problems. The set continuously measures the heading speed, drift speed and vertical speed of the helicopter and displays these relative movements on a single flight instrument. By maintaining the two index bars opposite the circle as in the photograph, the pilot is able to maintain his aircraft in a precise hovering attitude in conditions of poor visibility. The scale on the left of the instrument indicates vertical speed and is used to maintain a constant altitude. The doppler radar unit has a fixed antenna system with no moving parts, to ensure reliability. The set can also be used with a number of other equipments such as automatic stabilization, course and distance computers and ground speed/drift angle indicators.

Donner Scientific Company, Concord, Calif., has recently commenced production of this small analog computer, claimed to be the smallest ever made. The 10 amplifier model weighs 23 pounds and can be used to study almost any physical system that can be described by linear differential equations. For solving more complex problems, up to three of these computers can be interconnected together for 10, 20 or 30 amplifier operation.



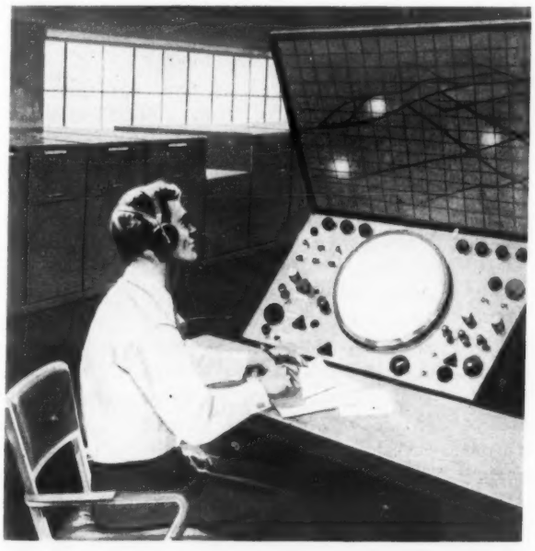
Marconi's Wireless Telegraph Co. Ltd., Chelmsford, Essex, has been responsible for the supply and installation of the world's first high power 50 cm radar equipment at Wellington Airport (New Zealand). A similar installation is also being made at Ohakea Airfield (NZ). The equipment is the 500 kW Marconi Type S 264A, and the system is designed to fulfil the dual function of providing both long-range airways cover and short-range airport approach control. Two-way microwave links are provided to pass the radar signals to displays at the airport and at the Airways Control Centre; the links also provide a path for the remote control of the radar head; the head itself is 52 1/2 feet long and weighs 7 1/2 tons. Owing to the possibility of earthquakes it is mounted on a concrete blockhouse which also houses the aerial turning gear and the dual transmitter/receiver installation. Operating on a 50 cm wavelength, the S 264A display is unaffected by precipitation, and a Moving Target Indicator obliterates the heavy clutter of permanent echoes which are produced by the mountainous country around Wellington Airport.

Philco Corporation, Philadelphia, Penn. has developed and supplied a number of extremely accurate radar target simulators to the Federal Electric Corporation N.J. Federal operates the DEW line (Distant Early Warning) for the U.S. Air Force. The simulator is designed for the training and practice of radar operators and does not interfere with normal operation of the radar equipment. Practice exercises can therefore be carried out with greater realism.



Consolidated Systems Corporation, Pasadena, Calif., a subsidiary of Consolidated Electrodynamics, has developed a lightweight engine vibration monitoring system which will be fitted on the DC-8 aircraft of Alitalia Airlines. The complete system consists of four vibration pickups, mounted one in each engine, a four channel amplifier and a single panel instrument. If vibration exceeds a preset level on any engine, a warning lamp glows in the cockpit; the pilot can then identify the engine and take remedial action.

Lockheed Electronics and Avionics Division, Los Angeles, Calif., has been developing a new method of air traffic control which automatically informs ground controllers of the location, identity and altitude of every aircraft in their area. Designated Loctracs (Lockheed Tracking and Control System), the basic elements are: an airborne transmitter in each aircraft, four ground receivers for each Loctracs sector, and a relay network connecting the receivers to a surveillance centre where the data is interpreted and displayed. A typical sector would measure from 70 to 100 miles on a side and can be subdivided into "surveillance sections" as small as 1/6 mile square where traffic is dense. Each airborne transmitter continuously sends out a pulse sequence that is independant of any other aircraft. The pulses are received by the four ground based receivers, and after decoding pass to the data display to indicate the aircraft's position. Low cost of the transmitter brings the system within the means of the private aircraft operator.



Boeing Airplane Company, Seattle, Wash., has designed the portable current-path verifier illustrated here. It is designed to enable an engineer to identify any particular current-carrying wire in the mass of cabling found in a modern aircraft. The hinged iron element closes round the wire and, if a current is present, an induced voltage causes the indicator to glow. The device is fully portable and is operated by batteries.

● Heiland Division of **Minneapolis-Honeywell Regulator Company** has recently introduced a new direct-recording oscillograph described as the Visicorder 1108. This is the third instrument to be introduced in the Visicorder range and allows high speed recording of up to 24 channels of data simultaneously. Recording capacity of the earlier 906 and 1012 model Visicorders is 14 and 36 channels, respectively. The model provides direct recording of high frequency information from DC to 5,000 c/s, and chart speeds are adjustable in 15 variations from 0.05 to 80 inches per second. Immediately readable records are produced by means of a mercury vapour lamp and ultraviolet sensitive record paper.

● **Decca Navigator Company** has recently installed a Decca chain in the Rome area for evaluation in respect of certain specific navigational functions. The location of the chain covers the bulk of the Rome Control Area from south of the airports of Ciampino and Fiumicino and extends to the north beyond Elba on Airway Amber 1 and Florence on Airway Amber 14. Demonstration flights have been carried out by the company's aircraft over routes requested by personnel of the Rome ATC. The flight plans have been designed to test the Decca system's capability of resolving ATC problems which exist in the Rome area. Results to date have been satisfactory and the trials are to be continued.

● **Sylvania Electric Products Inc.**, New York, have introduced a low priced, pocket sized Doppler Shift Calculator that provides quick determination of doppler shift for a wide range of velocities and frequences. It is available for engineers in the fields of radar, navigation and communications, where the phenomenon of doppler shift is of continually growing prominence.

● Stromberg-Carlson Division of **General Dynamics Corporation** has announced details of a new automatic acceptance tester for TACAN transceivers. The tester automatically sequences through the entire 126 TACAN channels without supervision and prints out the results on tape. It reduces the time to test transceivers manually from about seven hours, to 30 minutes. The equipment is self-checking, and no special skill is required for its operation.

● **Consolidated Electrodynamics Corporation's** Datalab Division has designed, developed and manufactured the magnetic tape recorder that will be used in the NASA *Project Mercury*. Minimum size, weight and power consumption were the basic design problems to overcome. The final unit measures 11 × 13 × 3 5/8 inches, weighs 12 pounds including 4,800 feet of tape, and requires less than eight watts of power. Apart from the voice commentary of the man in the space capsule, the instrument will also record phenomena detected by sensors taped to his body, together with such environmental conditions as temperatures, pressures, accelerations and shock. The tape capacity is sufficient for eight hours continuous recording.

● **Narda Microwave Corporation**, New York, has developed a new line of Harmonic Generators. The generators are available in three models which provide output frequencies from 53 to 90 Kmc.

The Martin Company, Baltimore, Md., is developing equipment for lunar explorers. Illustrated is a miniaturized U.H.F. radio transmitter mounted experimentally on a pilot's helmet. The use of U.H.F. transmissions has been decided upon in order to give a range of communication in a lunar environment about equal to that of a human voice. The proposed aerial radiation pattern will be forward and directional, with a switching device to give full power omni-directional radiation in case of emergency.

What's Wrong With European Air Transport?

By Dr. Ing. F. W. Petzel, Manager, Hanover-Langenhagen Airport

It is, first and foremost, the airline user who is best qualified to decide what demands can most justifiably be made on air transport. There is no doubt that time and time again he is refusing to travel by air because of the shortcomings in the existing air transport system. Compared with the railways, which are continually improving—the successful introduction of TEE trains in the European economic zone is but one example—air transport does not cut a particularly impressive figure. The result is that the train or the motor car, and not the aircraft, is chosen for many business and private trips inside Europe, even on longer routes; and the reason is hardly to be sought in the restricted area of the continent.

Airline users' criticism turns on the following questions:

— Why are so few services offered in the European area, and why do routes, timetables and frequency of services take so little account of travellers' wishes?

— Why is so much time wasted in surface transport before and after a flight? Cannot waiting times at airports be lessened for passengers in transit?

— Why are delays and breakdowns in scheduled operations still so frequent, particularly during the winter season?

— Why are fares for short and medium stages still so high that they are often out of all proportion to the time gained in travelling by air?

Any European who often travels by air will endorse these complaints. How can the present situation be improved?

Services offered by European companies

The timetables and route networks of airlines in the OEEC area[1] show the services offered in the European region. In most cases stress is laid on intercontinental traffic, particularly to North America. Interest in purely European traffic is limited, with few exceptions, to routes and frequencies meeting feeder service requirements for lucrative intercontinental traffic; comparatively few services are offered on most short and medium stages inside Europe. This is one of the weaknesses of the European air transport system, in which it is fundamentally different from that of the USA.

It is, of course, obviously cheaper, and hence more profitable, to produce a tonne-kilometre on a long route than it is on short and medium stages. One should not, however, overlook the fact that the requirements of most European passengers are not for intercontinental, but for continental traffic. According to recent investigations made by a traffic research institute, the number of intercontinental trips made accounts for only 10 percent of all air traffic in the German Federal Republic. Naturally, there is a lower limit to stage lengths if airlines wish to entice customers without losing money. According to experience in the United States it would be an attractive proposition to create, in addition to long non-stop flights, services with minimum stage lengths of 200 miles and a certain daily minimum frequency, between the major economic centres of Europe. As in such a system demand would be fairly well distributed over individual stages, the airlines would, on the whole, be able to utilize their aircraft better. That this is no mere Utopian theory has been proved by the example of the twelve leading U.S. trunk operators, whose average stage lengths are between 200 and 250 miles. Stages of the same length and kind, though possible in Europe, have not yet been created in sufficient quantity.

There are further reasons for the limited number of European services. It is well known that all governments are trying to secure for their national companies the largest possible share of the volume of domestic and international traffic by incorporating clauses to this effect in bilateral air agreements. These are entirely justified in the case of two widely separated countries such as, say, Great Britain and Mexico or Canada and France, but in Europe, where each country has a relatively small area and population, such a practice will considerably inhibit the development of air traffic.

Experience in recent years has shown that, as long as governments maintain their present attitude, the airlines obviously cannot, from a purely commercial point of view, arrange their traffic to satisfy the airline user, at least as long as routes are designed primarily to meet the needs of intercontinental traffic. If each company—often with an inadequate fleet—is striving to attract customers at the expense of competitors, then routes, frequencies and timetables in the European area must inevitably suffer, and it will be impossible to work out a rational system of timetables in the interests of all.

In this respect the European railways have acted far more logically. They have agreed on the speeds and frequencies of trains to meet traffic requirements, in this way serving the passenger's interests as well as their own.

Can transport times on the ground be reduced?

This question has long been under investigation by ICAO and IATA, but so far without any major degree of success. During recent years transport times on the ground have not only not been reduced, but have even increased with the introduction of larger aircraft. The main aim must therefore be quicker passenger and baggage handling in relation to total travelling time. Consideration must therefore be given, not only to higher aircraft speeds, but also to the time spent in transporting passengers to and from the aircraft and in waiting at airports.

With the normal European airport bus service the passenger and baggage handling system is subjected to peak loads which cause delays. Now that the number of passengers per aircraft is growing, clearance times will be further increased, which means that airport buses will have to set out earlier from town terminals. It is understandable that passengers travelling on short routes with light luggage will complain at having to waste half an hour or more waiting around at airports. Unless airport bus services can be run at frequencies of, say, 10 to 15 minutes, so that the increasing passenger load is spread, the only solution will be to complete as many formalities as possible at the town terminal, so that the buses can leave later. An investigation of the advantages of such a system has revealed that, psychologically at any rate, a certain degree of progress can be achieved. If passengers and baggage are cleared, say, at the main railway station, the passenger

[1] OEEC area = territories of member States of the Organization for European Economic Cooperation.

can have his ticket and baggage checked immediately after his train arrives—and here the passport and customs authorities might also cooperate. On continental routes bus departure times could be so arranged that the passenger would not need to arrive at the airport until 15 minutes before his aircraft leaves. In this way he could save half an hour or more. Passengers arranging their own transport would, of course, have to be cleared on arrival at the airport, but in their case airport waiting times would be greatly reduced since the question of peak loads would no longer arise.

Airport passenger handling could be further simplified by introducing the American system of fingers and letting passengers find the way to their aircraft themselves, instead of making them congregate in waiting rooms and leading them all to the aircraft at once. Such a solution would, however, require major structural modifications to most European terminal buildings.

Long stops at airports by passengers in transit or changing aircraft can also be considerably shortened by rational measures. In the former instance, as in the USA, passengers should no longer be required to get out of the aircraft, and in the case of flights crossing frontiers they should not be compelled to undergo customs and passport checks in the terminal building. With proper handling, transit stops could be reduced to 10 to 15 minutes. But, if a coordinated European route network is to be created, it will also be imperative to arrange good connections and reduce the time spent in changing aircraft. The latter should not normally exceed 30 minutes.

Can flight delays and cancellations be avoided ?

If we examine the European airlines' record for regularity, particularly during the winter months, then the picture is anything but satisfactory: delays are the rule and cancellations not infrequent. Travellers would certainly use air transport far more often, even during periods of bad weather, if something could be done to improve this situation.

The reasons for poor regularity in European services are due to operational safety requirements, in themselves justified: below certain "bad weather minima" scheduled flights may not take off or land. To improve regularity it would be necessary to lower landing minima by the use of new traffic control equipment, naturally without reducing the safety factor on take-off or landing. Airlines and insurance companies would undoubtedly agree to new solutions of this kind as long as they did not involve increased risk.

Can fares be reduced ?

In the view of air travellers, air fares—particularly on international routes—are too high in relation to railway fares to be attractive for the majority of journeys.

As is well known, international air fares are unanimously agreed by IATA, and the same basic rates apply on the relatively short intra-European routes as on intercontinental services. On purely domestic routes, however, which are often longer than many international routes inside Europe, air fares are appreciably lower (as in the USA, whose domestic rates are about half those imposed by IATA).

If a higher passenger volume is to be achieved in intra-European air traffic, it will be essential to base fares on other considerations than hitherto. An attempt should be made to set unified fare rates for the OEEC member States, taking account of the relative incomes of European airline users, and valid for all intra-European routes. Steps could be taken towards popularizing air travel by bringing air fares nearer the level of first-class rail fares with TEE or express supplements.

Can improvements be achieved through better organization ?

Basically speaking, a purely national outlook must be abandoned in favour of a "pan-European" spirit.

It is to be hoped that European airlines will adopt the view that competition, which in the long run will be against their interests, must be limited in favour of a system of timetables jointly planned by all the European countries. The pool agreements often concluded between airlines are more in the purely commercial interests of the companies concerned than in those of the airline user. A new approach to the better utilization of air fleets has been made by Air France, Alitalia, Lufthansa and Sabena (formation of Air Union) on the one hand, and by SAS and Swissair on the other.

From the passenger's point of view it would be desirable to go a step further and win over as many as possible of the airlines in OEEC countries to the idea of linking vital points in the European economic area by " European transversals." Purely domestic stages could then be incorporated in these routes. An integrated European network would improve fleet utilization, raise the frequency of services and enable flight times to be adapted to traffic requirements. The "European transversals" would thus form a parallel to the TEE rail routes, but would enable the public in the neighbouring economic regions to travel much quicker than by rail.

The governments of OEEC States should support new developments by assistance of various kinds. Efforts towards a multilateral agreement on European air traffic have so far, however, been unsuccessful. The governments of OEEC States and the national airlines financially dependent on them should realize once and for all that there is little to be gained by maintaining the present *status quo* in Europe.

Experience of "free" competition between airlines in the USA does not indicate that requirements would be better met by its introduction in an economically united Europe. In the United States it was " regulated " competition which led to the astonishing success of the air transport industry (which now accounts for over 50 percent of world air traffic !). Although there is keen competition between the companies themselves, routes and fares on the U.S. airlines are subject to careful scrutiny by the Civil Aeronautics Board (CAB), a body which is answerable only to the President of the United States and whose decisions are based on the principle of satisfying traffic requirements. One can envisage the creation of a similar authority in Europe, at first perhaps in an advisory capacity, for whose approval proposed routes could be submitted along with the reasons for the request. Examination of proposals should extend to all route connections in OEEC States and cover both intra-European and intercontinental routes served by the national companies.

Are these proposals economically feasible for the airlines ?

Any proposals for improving the existing situation will be acceptable to the airlines only if they guarantee financial success for each company. At any rate, there can be no talk of common economic solutions. The question therefore arises as to whether a coordinated European route network based on the considerations discussed above can work more economically than the separate national ones of today. The answer to this question is *yes*. It should also be considered whether more rational operating methods might not bring about the reduced operating costs which will be necessary to lower fares and reach wider sections of the travelling public. Passenger volume could be increased and new traffic generated by operating, in successful competition with the railways, stage lengths of 200 to 500 miles; these are the distances most attractive to travellers. The psychological conditions for an increase in international traffic are at present highly favourable to the growth of both business and private travel, as is shown by transport statistics, whose figures increase from year to year.

The profitability of the European national airlines should not, however, be overestimated. Financially they depend without exception on their governments and are encouraged by subsidies for reasons of economic necessity. Even a slight rise in the costs of ground organization could have adverse economic results. The governments concerned should therefore exercise restraint in imposing new charges so that the reduced operating costs achieved by rationalization will have the effect of lowering fares.

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Book Reviews

Grondbeginselen van de Ruimtevaart. By M. Vertregt. Published by De Erven F. Bohn N. V., Haarlem, 1959 (Dutch; 208 pages; tables, bibliography and index; price 16 guilders).

This book on the basic principles of space travel is written for the educated reader (who has not forgotten his mathematics) who wishes to gain a wider and more reliable knowledge of space problems than is obtainable from popular works on the subject. The author is a member of the Netherlands Space Travel Society and a Fellow of the British Interplanetary Society and has devoted many years to the study of his subject. His book is claimed to be the first in any language to provide the bases on which the thoughtful reader can form his own opinion of coming astronautical achievements. Individual subjects treated are: Why space travel? history of the rocket; the simple rocket; the principle of rocket motion; the construction of the liquid-propellant rocket; basic principles of astronautics; the step rocket; position finding in space; interplanetary trajectories; the heavenly bodies and interplanetary space; and the future of space travel. St.

Raumfahrt — technische Überwindung des Krieges. — By Eugen Sänger. — Verlag Rowohlt, Hamburg, 1959 (German; 144 pages; price DM 1.90).

Professor Eugen Sänger, founder of the Research Institute for the Physics of Jet Propulsion, Stuttgart, needs no introduction to readers of *Interavia* Review, for his articles have made him well known as a specialist in all branches of astronautics. The Rowohlt paperback gives a brief introduction, easily understandable by the layman, into the military and civil aspects of the subject—historical development, scientific principles, technology, space traffic problems etc. His aim is clear from the title: the abandonment of space as a purely military concept and the vigorous promotion of civil space travel.

ro-ro-ro paper-backs are a veritable mine of information, and the " Rowohlts deutsche Enzyklopädie " series, to which the present volume belongs, contains many interesting volumes, such as " Das Naturbild der heutigen Physik " (Vol. 8) by Werner Heisenberg; " Die Evolution der Physik—Von Newton bis zur Quantentheorie " (Vol. 12), by Albert Einstein; and " Die Strahlengefährdung des Menschen durch Atomenergie " (Vol. 91), by Hans Marquardt and Gerhard Schubert. He.

The Seven Skies. By John Pudney. Putnam, London, 1959 (English; 320 pages; 19 photos; 30 shillings).

The name John Pudney will be familiar to many readers as an author and poet who has made aviation his theme. " The Seven Skies " is described as a study of BOAC and its forerunners since 1919, and is a further example of his work in this field. It is essentially a selection rather than a chronological history and is all the more pleasant to read for being so. The author traces the story from 1919, the early struggles, the successes and also the failures of a relatively small number of men who believed that civil aviation was a feasible method of transport and writes as an observer rather than as an expert with a specialized knowledge of civil aviation. Consequently, the book does not endeavour to state a point of view. It is a backward glance at forty remarkable years, remarkable for the speed at which the new industry developed and for the developments within the industry itself. Some readers may demand more technical details but will have to rest content with the table provided at the end of the book which lists the aircraft employed by BOAC and its predecessors. For the rest it will revive some half forgotten memories and provide a clearer picture of the development of civil aviation. EKB

Brandlehre und chemischer Brandschutz. — Edited by Ludwig Scheichl. — Dr. Alfred Hüthig Verlag GmbH, Heidelberg, 1958 (German; 420 pages; price DM 28.00).

In the introduction the editor and publishers point out that there has so far been no systematic work summarizing experience and knowledge gained in the field of fire protection. The publishers have, therefore, decided to bring out a series of volumes under the collective title of " Bücherei der Brandschutzwissenschaft. " The present volume is an introduction to the physical and chemical principles of fire protection and includes an exhaustive discussion of thermodynamics as the most important principle. The main chapter deals with the thermodynamics of fires, their kinetics, and with the chemistry of fire-extinguishing substances. The final chapter is on nuclear energy, its technical applications, the danger of fire involved in its use, and the necessary protective measures. Ba.

First Colloquium on the Law of Outer Space. — The Hague 1959 Proceedings. — Edited by Andrew G. Haley and Dr. Welf Heinrich, Prince of Hanover. — Springer-Verlag, Vienna, 1959 (English; 126 pages; price Sfr. 19.50; Sfr. 15.60 to members of the International Astronautical Federation).

This is a collection of short papers read at the First Colloquium on the Law of Outer Space held in the Hague in 1958, which led to the creation of a permanent legal committee within the International Astronautical Federation (IAF). The active President of the IAF, A.G. Haley, has won the cooperation of leading air and space lawyers, making this colloquium of particular significance for the elaboration of future laws. He.

Alles over Straalvliegtuigen. By Hugo Hooftman. Published by La Rivière & Voorhoeve, Zwolle, 1959 (Dutch; 188 pages; 104 photographs and 10 drawings; price 7.90 guilders).

Hugo Hooftman, the well-known Dutch aviation writer, here sets out to tell the story of jet aircraft from the earliest work in Germany and Britain up to the present day and to projects for the future. He writes for the man in the street, particularly the younger generation, and his style is accordingly lively and almost conversational. All in all, the book can be said to present a gripping story for its chosen audience. St.

British Civil Aircraft 1919-1959, Vol. I. — By A. J. Jackson. Putnam and Co., London, 1959 (English. 576 pages; 500 photographs; 63 shillings).

Vol. I of " British Civil Aircraft " covers the list of manufacturers alphabetically from A-D and is described in the foreword as a work of reference. This description does it less than justice for although it will obviously be used for reference by its owners, it possesses many other attractions. Apart from providing the essential items of information, dimensions, three view drawings and details of mark variants, the real pleasure to be had from the book lies in the historical details which have been included. There are many readers who no doubt will be able to trace the career and eventual fate of aircraft of which they have personal experience. It may even lead to the resumption of old friendships. It has been the author's intention to clear away some of the confusing rumours, anecdotes and, in some cases, sheer guesswork which obscure the history of many civil aircraft. By accounting for all the civil registrations issued during these forty years, the listing also includes aircraft of foreign manufacture which were owned and operated in Great Britain. A word of warning to enthusiasts who may wish to discover the fate of the aircraft they once flew or owned. Vol. I covers the manufacturers from A-D; if their aircraft lies outside this list, they must be patient until further volumes appear. The wait, however, will be worth while. EKB.

Über Raketen. — Von Helmut Gröttrup. — Verlag Ullstein, Berlin-Frankfurt-Vienna, 1959 (German; 244 pages; 151 illustrations; 24 plates; price DM 16.50).

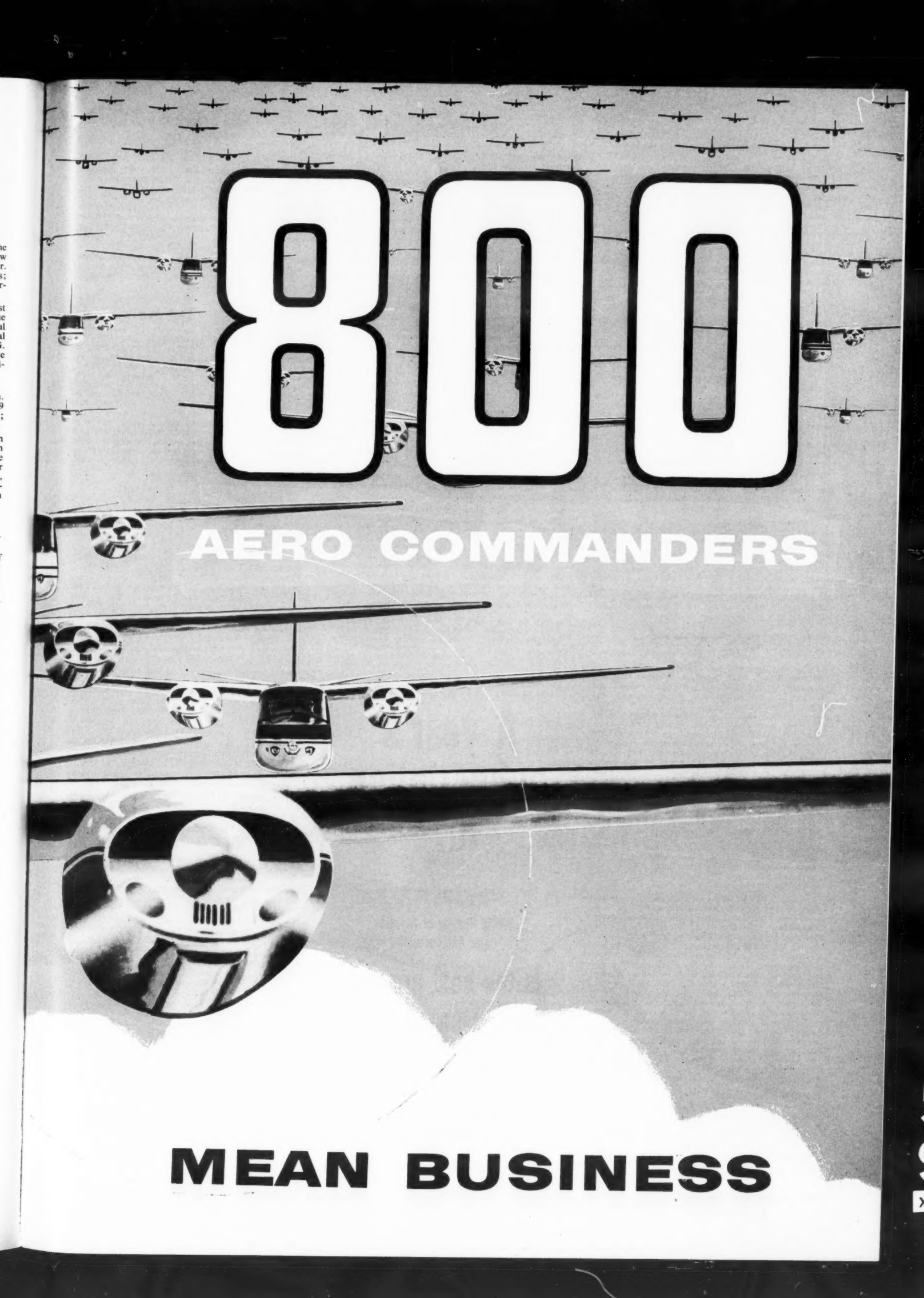
This clearly-written introduction into the physics and techniques of rocketry is in the nature of a " plain man's guide to missiles. " The author, who formerly worked on the V2 at Peenemünde and spent seven years after the war at the head of a group of rocket specialists in the USSR, makes the layman familiar with the structure and operation of rockets and their parts. The reader will learn everything worth knowing about well-known types such as the V2, the *Nike*, the *Atlas*, the *Vanguard*, the Soviet *Sputniks* and projected rockets. The fact that Gröttrup's book contains no mathematical formulae and symbols, should make it welcome to a large number of readers in the age of artificial satellites. Ba.

Pilot und Hostess. — By Ernst Wetter. — Schweizer Jugend-Verlag Solothurn, 1959 (German; 139 pages; 16 full-page pictures; price Fr. 9.20).

In his latest book Ernst Wetter, instructor to the Swiss Air Force, addresses himself to the younger generation, telling the story, with a wealth of technical knowledge and human sympathy, of a brother and sister who decide to make their careers with an airline. Skilfully interwoven with the grippingly told story are countless practical tips for young readers interested in going into the aviation business. A book to be recommended not only to these readers but also to their parents. Ha.

Jahrbuch 1958 der Wissenschaftlichen Gesellschaft für Luftfahrt e.V. (WGL). Edited by Hermann Blenk in collaboration with Werner Schulz. Verlag Friedr. Vieweg & Sohn, Brunswick, 1959 (German, English, French; 300 pages; price DM 38.—).

Like its predecessors, the latest WGL yearbook contains in its main part the papers read at an annual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meeting of the WGL, in this case the Stuttgart conference held from October 8th to 11th, 1958, with a total of 49 papers. The appendix contains a roll of honour, obituaries and reports on the WGL's activities and awards. The contents of this yearbook are of the greatest scientific value, and its presentation is, as usual, impeccable. Ri.

Jahrbuch der Luftfahrtforschung der Deutschen Demokratischen Republik 1959. — Edited by H. Aspe. Published by the Central Office for Literature and Instructional Material on behalf of the Union of State-Owned Aircraft Manufacturing Plants. Distributed by Redaktion Deutsche Flugtechnik, Dresden N.2, Postfach 40 (German; 128 pages; 179 illustrations; 19 tables and diagrams; cloth-bound; price DM 14).

For the first time since the creation of the German Democratic Republic leading East German aeronautical experts have produced a yearbook which is equally impressive for its content and its presentation. It contains contributions from 15 writers, including University professors Dr.-Ing. G. Backhaus (The Profitability of Air Transport as Basic Requirement in the Design of Commercial Aircraft) and Dr.phil. G. Cordes (Design Problems in Jet Engines and their Influence on the Profitability of Air Transport). The preface is by Professor Brunolf Baade, who closes with the words: "May this yearbook help to promote the exchange of practical knowledge with all experts in West Germany and beyond the German borders, and make a real contribution to progress in peaceful aviation." An appendix gives a brief summary of the individual papers in German, English, French and Russian. Ri.

Space Age Dictionary. — By Charles McLaughlin. — D. Van Nostrand Company, Inc., Princeton, N.J. (English; 128 pages; price $5.95).

An illustrated dictionary of the space age explaining the most important terms dealing with rockets, satellites and space research, will surely be welcomed by many libraries. The author, who is President of the McLaughlin Research Corporation of New York, has now compiled such a work, which will be particularly helpful to the layman in the study of technical literature. Although many important terms appear to have been sacrificed for the sake of conciseness, this little book should nevertheless have great appeal for the non-technical reader. Re.

Meteorologische Navigation des Segelfluges. By Walter Georgii. Friedrich Vieweg & Sohn, Brunswick, 1959 (German; 135 pages; 64 illustrations; price DM 9.80).

The author, for many years Director of the Deutsche Forschungsanstalt für Segelflug (German Research Establishment for Gliding), is a well-known meteorologist who has had connections with gliding since the first Rhön soaring contests. Much of the progress made in gliding has been due to his observations and research. In his latest book he shows how weather conditions can be used to obtain better performance from sailplanes, enabling an observant sailplane pilot to prepare his flights and select the best moment for take-off. The author deals in detail with the power sources used in gliding, and the second part is devoted to the weather conditions for high performance flight. The inherent dryness of the subject matter is relieved by numerous examples of typical flights, illustrated by sketches, barograms and weather charts. This is a book which deserves a wide circulation, and it is also recommended to amateurs of powered sports flying. De.

Industrielles Fernsehen — Praxis und Planung in Wissenschaft, Technik, Wirtschaft und Verwaltung. By Chr. Rose. Published by R. Oldenbourg, Munich, 1959 (German; 333 pages; 253 illustrations and 15 Tables, price DM 57).

The title of this book is a little misleading because the subject is not just "Industrial Television," but rather closed-circuit television systems and their applications. Closed-circuit television is no novelty; it is already widely used in hospitals, factories, and in all types of research where the observer must be isolated from the operation that he wishes to monitor. But technical progress during the past few years has greatly widened the range of uses and this book is useful because it brings into focus the true scope that television has in everyday life on land, under the sea, and in the air. In a short but interesting section the author discusses the importance of TV in air traffic control, navigation, meteorological forecasts, and aeronautical research and training. During landing and take-off, aircraft can now be televised even during bad weather and pilots can thus be given added guidance from the control tower. The advent of transistors has made compact television transmitters and receivers feasible, and airborne TV will doubtless find many further uses in the future. Pe.

Deutschland im Luftbild — Süden, Westen, Norden. Compiled by Bernd Lohse. Picture texts by Eva-Maria Wagner. Introduction by Peter Supf. Umschau-Verlag, Frankfurt a.M., 1959 (captions in German, English and French; 192 plates; 32 pages of text; cloth-bound; price DM 25.80).

Impressive collections of aerial photographs of landscapes, residential and industrial centres etc., have recently been published in France, Switzerland, the USA and many other countries. The present German contribution, compiled from the records of eleven German aerial photography firms and art publishers, testifies to the unerring taste and artistic sense of the compiler and at the same time shows the technical progress made in aerial photography in Germany during recent years. There is much charm in the contrast between modern scenic features such as television towers, atomic reactors, mountains of rubble and motorways, and the peaceful beauty of medieval towns, regattas on mountain lakes, castles and parks. This is a fine book indeed. He.

Wernher von Braun — By Heinz Gartmann. Volume 14 of the series "Köpfe des XX. Jahrhunderts." Colloquium Verlag O.H. Hess, Berlin-Dahlem, 1959 (German; 96 pages; 6 illustrations; price DM 4.50).

"Short Biographies of Great Contemporaries" is the sub-title of this varied assortment of biographical sketches, in which such different figures in science, art and politics as Werner Heisenberg, David Ben Gurion, Haile Selassie, Pablo Picasso and Ortega y Gasset are represented. It was a happy thought to entrust this brief biography of Wernher von Braun to the space travel expert Heinz Gartmann, for both belong to the younger generation of rocket scientists who, in the footsteps of Goddard, Oberth and Esnault-Pelterie, made the transition from theory to practice and, despite the armaments production in which they are engaged, are firm advocates of space travel for peaceful purposes. As Wernher von Braun, quoted by Gartmann, puts it: "We have not invented and built rockets for the destruction of our planet, but to reach other worlds." He.

Ikarus Ikarus... (Novel) By Werner Helmes. Verlag Stahlberg, Karlsruhe (German; 360 pages; cloth-bound; price DM 16.80).

There is no lack of novels whose ingredients are a mixture of modern science and old-fashioned love. For this recipe the author takes a "thoroughbred" supersonic research aircraft, a daredevil test pilot, an ambitious designer, a Ministry of Aviation not above shady intrigue and, of course, a lady, or rather two ladies with a "penchant" for birdsong, the wide open spaces and test pilots; literary quotations to taste. Anyone with long winter evenings to fill should read this book and comfort himself with the thought that, when the test pilot is killed, he is sacrificed only for the reader's sake. He.

Ich lebte im Jahr 3000. By Werner Wehr. Edited by Heinz Gartmann. Mundus-Verlag Stuttgart, 1959 (German; 296 pages with explanatory appendix and glossary of technical words; price DM 14.80).

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"The story of a possible journey" is the sub-title of this book written under a pseudonym by a well-known rocket expert. Although clearly and logically depicted, this trip to the stars makes considerable demands on the reader's imagination: the characters in the book leave our planet for 25 years and return to find that, while they themselves are only 25 years older, 1,100 years have gone by on earth. Anyone who likes adventure and excitement will find just what he wants on the spaceship "Terrella." Ha.

Das Recht des Hubschrauberfliegers in der Bundesrepublik Deutschland. — By Dr. Elmar Vogels. — Verlag Michael Triltsch, Düsseldorf, 1958 (German; 99 pages; board; price DM 12.80).

With the exception of the USA and Italy (whose jurists received encouragements of all kinds from the vertical flight congresses held in Italy), the quantity of specialized literature on helicopter law is somewhat slight. Dr. Vogel's carefully prepared monograph is therefore very welcome. For it is quite clear that, in addition to the provisions of general air law, many special rules will have to be devised for the helicopter, in view of its characteristics and flying qualities: slow flying and hovering, and ability to operate independently of airports. Many people will be grateful to the author for his conscientious "exposé" of present-day and future law—type certification, landing, liability, etc. Whether, from the huntsman's point of view, his information is quite as reliable, is another matter. For, judging from his suggestion that huntsmen might watch game from helicopters hovering near the ground, he appears to under-estimate the hearing of the fowls of the air and the beasts of the field. He.

Books received

Reports of the Deutsche Versuchsanstalt für Luftfahrt e.V. : edited by the Zentrale für Wissenschaftliches Berichtwesen der DVL, Mülheim, Ruhr; Westdeutscher Verlag, Cologne and Opladen, 1958/59:

Report No. 75: Über den Einfluss des Gleitens bei verdünnten Gasen auf die Entstehung der Taylor-Görtler-Wirbel, by K. Kirchgässner (price DM 9.30).

Report No. 76: Über den Brechungsindex von Wasserdampf-Luft-Gemischen bei Dezimeter- und Zentimeterwellen, by M. Vogel.

Report No. 77: Über Eigenschaften von Wirbelstrassen, by A. Timme (price DM 12.—).

Report No. 78: Berechnung der Beulwerte von Platten unter ungleichmässiger Temperaturbeanspruchung nach dem Mehrstellenverfahren, by W. Schnell and G. Fischer (price DM 11.30).

Report No. 79: Der Einsatz elektronischer Rechenanlagen bei der Lösung funknavigatorischer Aufgaben im Flugzeug und am Boden, by Th. Feger (price DM 26.20).

Report No. 81: Übertragung der Görtler'schen Reihe auf die Berechnung von Temperaturgrenzschichten (Teil 1), by E. Wrage (price DM 12.80).

Report No. 82: Betrachtungen über einen elektrokinetischen Generator, by A. Walz (price DM 6.60).

Report No. 84: Beitrag zur Näherungstheorie kompressibler turbulenter Grenzschichten, by A. Walz (price DM 14.50).

Report No. 85: Laminare Grenzschichten in der Magnetohydrodynamik, by G. Jungclaus (price DM 8.20).

Report No. 86: Die eingespannte, an den Rändern versteifte, dünne Rechteckplatte mit gleichmässig verteilter Belastung, by O. Volkersen (price DM 17.30).

Report No. 88: Orientierende Untersuchungen über die Alterung von Schmierölen im praktischen Flugbetrieb (price DM 7.30).

Report No. 90: Antriebe mit Heizung bei Überschallgeschwindigkeit, by K. Oswatitsch (price DM 9.20).

Report No. 92: Stabile Formen und Übergangserscheinungen der Flachwasserströmung auf einer schwach geneigten ebenen Platte, by D. Huhnt (price DM 16.70).

Report No. 94: Ähnlichkeitskennzahlen bei Verbrennungsvorgängen in Brennkammern von Strahltriebwerken, by G. Winterfeld (price DM 10.80).

Report No. 95: Theoretische Untersuchungen des chemischen und physikalischen Zustandes der Atmosphäre als Grundlage für experimentelle Untersuchungen ihrer möglichen Einwirkung auf die Materialien von Flugkörpern, by U. Schmieschek (price DM 11.90).

Publications scientifiques et techniques du Ministère de l'Air : Edited by the Service de Documentation et d'Information Technique de l'Aéronautique, Paris, 1959:

No. N.T.80: Actes du Colloque de Calcul Numérique.

No. N.T.81: Influence de la température sur le comportement cristallin du fer soumis à des déformations par torsion alternée, by Jacques de Fouget.

No. N.T. 82: L'interprétation des Mesures par la Clause de Régularité, by Pierre Vernotte.

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Papers and addresses, Brunswick, June 23rd, 1959.

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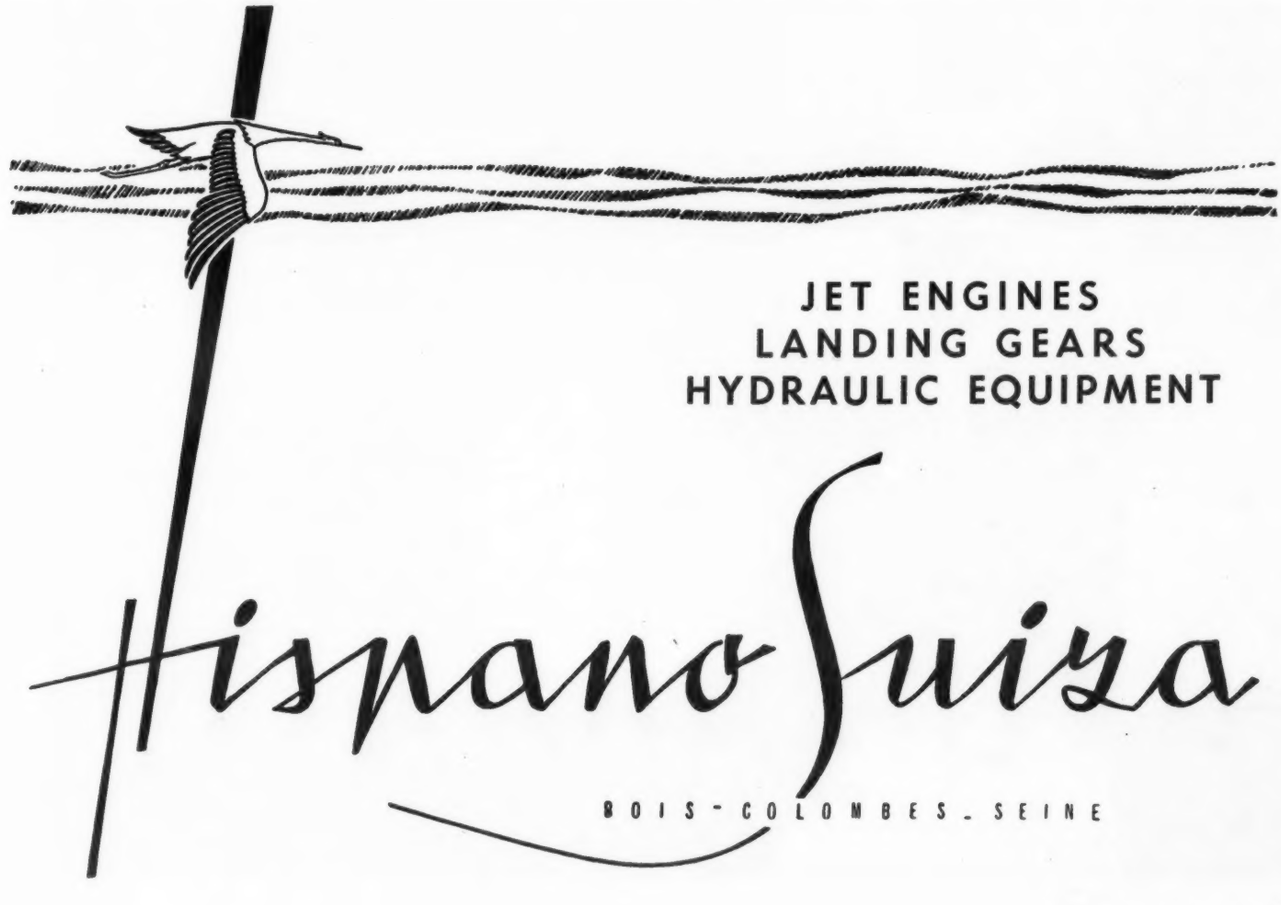

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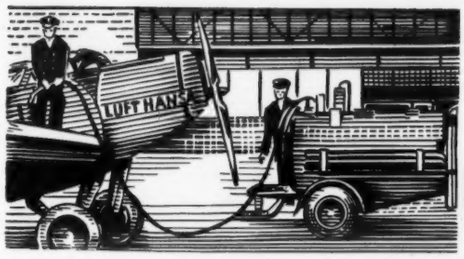

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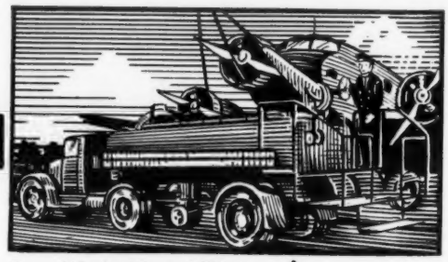

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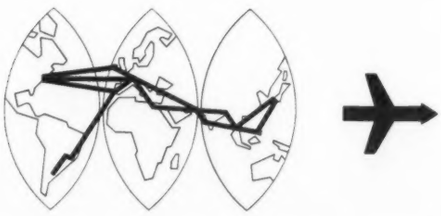

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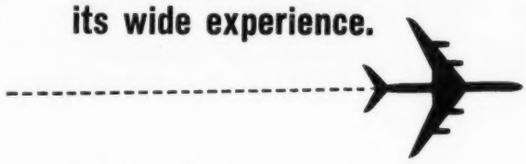

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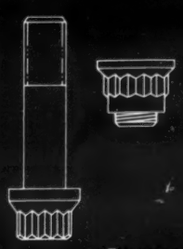

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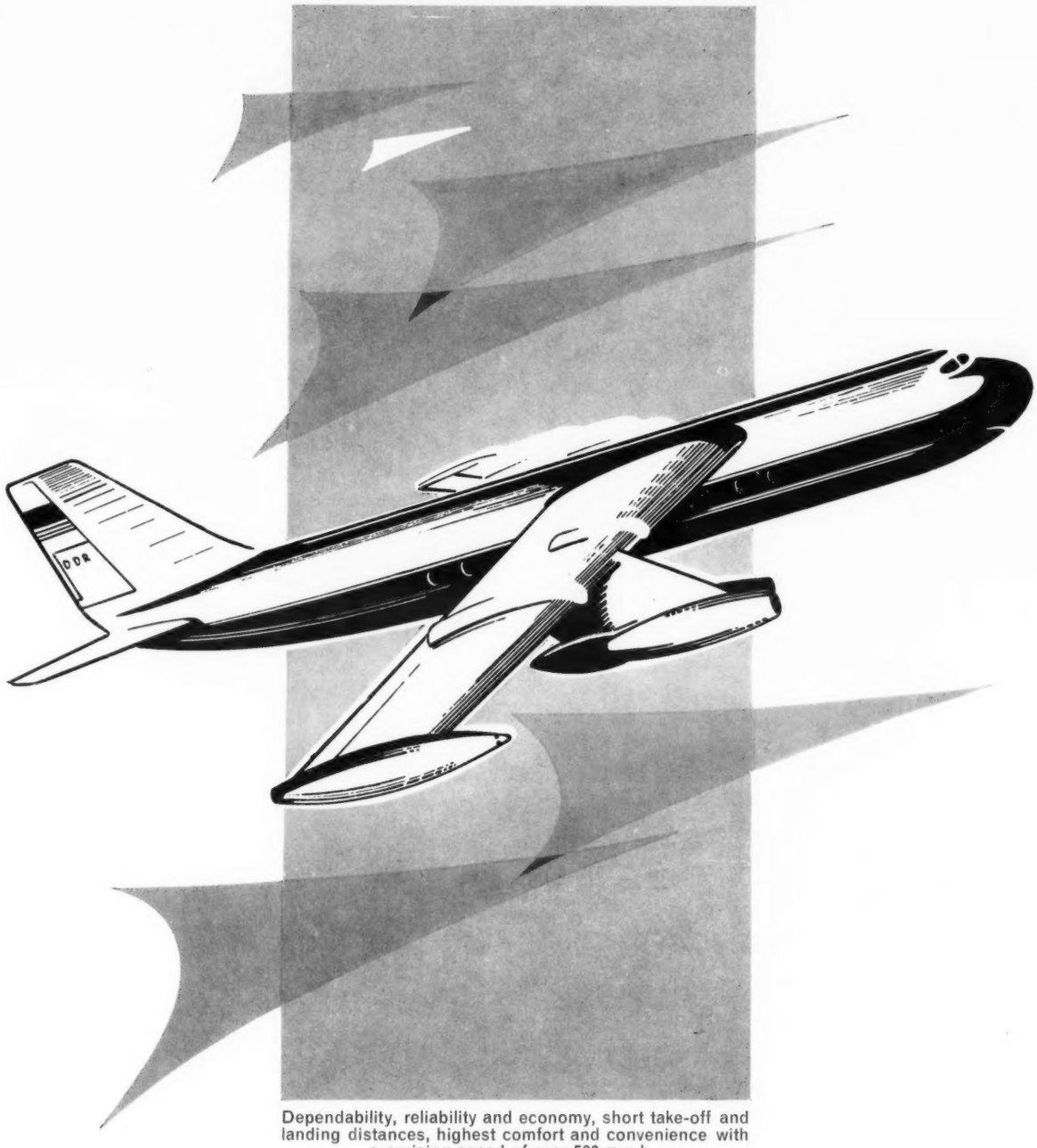

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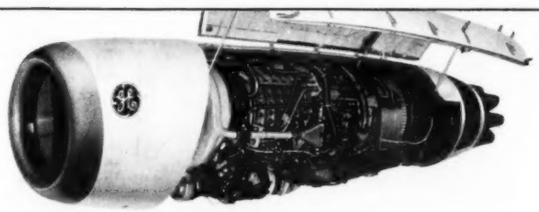

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